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CONTENTS

Chemistry Musing Problem Set 33	8
JEE Advanced : Model Test Paper 2016	11
AIPMT Practice Paper 2016	20
Advanced Chemistry Bloc	26
You Ask, We Answer	30
JEE Main Practice Paper 2016	31
AIPMT Model Test Paper 2016	37
Chemistry Musing Solution Set 32	45
Concept Map	46
AIIMS Practice Paper 2016	48
BITSAT Practice Paper 2016	55
Olympiad Problems	62
JEE Advanced Practice Paper 2016	66
Concept Booster	73
CBSE Board Class XII Solved Paper 2016	76
Crossword	85

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CHEMISTRY MUSING

Chemistry Musing was started from August '13 issue of Chemistry Today with the suggestion of Shri Mahabir Singh. The aim of Chemistry Musing is to augment the chances of bright students preparing for JEE (Main and Advanced) / AIPMT / AIIMS / Other PMTs & PETs with additional study material.

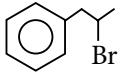
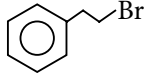
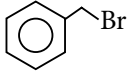
In every issue of Chemistry Today, 10 challenging problems are proposed in various topics of JEE (Main and Advanced) / AIPMT. The detailed solutions of these problems will be published in next issue of Chemistry Today.

The readers who have solved five or more problems may send their solutions. The names of those who send atleast five correct solutions will be published in the next issue.

We hope that our readers will enrich their problem solving skills through "Chemistry Musing" and stand in better stead while facing the competitive exams.

PROBLEM Set 33

JEE MAIN/PMTs

- Ions with d^8 configuration may form both octahedral and tetrahedral type complexes then the crystal field stabilisation energies for these complexes are respectively,
 - $-1.2 \Delta_o$ and $-0.36 \Delta_o$
 - $-1.2 \Delta_o$ and $-0.8 \Delta_o$
 - $-2.8 \Delta_o$ and $-0.8 \Delta_o$
 - $+1.2 \Delta_o$ and $+0.36 \Delta_o$
- Which of the following alkyl halides has highest solvolytic reactivity when they are converted into alcohols through S_N1 mechanism?
 - 
 - 
 - 
 - CH_3Br
- When an acyl chloride reacts with amine, it is necessary to take amine in excess while excess of alcohol is not required when it reacts with acyl chloride because
 - amine gets protonated by HCl produced as a by-product
 - lone pair of nitrogen is attacked by chlorine
 - alcoholic oxygen does not get protonated easily
 - alcohol shows very high reactivity than amine.
- Consider the following first order reaction taking place at 308 K in 0.5 N HCl.

Sucrose \rightarrow Glucose + Fructose

At $t = 0$, the initial total rotation of the mixture is 32.4° . After 10 minutes the total rotation of sucrose is 28.8° . If the rotation of sucrose per mol is 85° , that of glucose is 74° and fructose is -86.04° then the half-life of the reaction is

- 114.2 min
 - 59.6 min
 - 75.2 min
 - 98.6 min
- A photon of wavelength 1.4 \AA collides with an electron. After collision its wavelength becomes 2.8 \AA . How much energy is associated with the scattered electron?
 - $1.4 \times 10^{-10} \text{ J}$
 - $2.8 \times 10^{-10} \text{ J}$
 - $7.10 \times 10^{-16} \text{ J}$
 - $4.26 \times 10^{-16} \text{ J}$

JEE ADVANCED

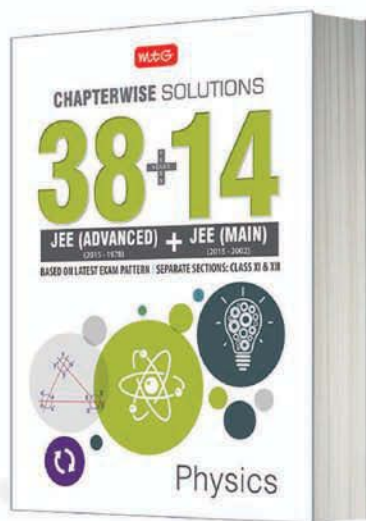
- A quantity of air ($\gamma = 1.4$) at 300 K is compressed slowly in case I and suddenly to half of its volume in case II. Which of the following is correct regarding the change in temperature in both cases?
 - Case I, $\Delta T = 0 \text{ K}$, case II, $\Delta T = 395.36 \text{ K}$
 - Case I, $\Delta T = 395.36 \text{ K}$, case II, $\Delta T = 95.36 \text{ K}$
 - Case I, $\Delta T = 10 \text{ K}$, case II, $\Delta T = 368.36 \text{ K}$
 - Case I, $\Delta T = 0 \text{ K}$, case II, $\Delta T = 95.36 \text{ K}$

COMPREHENSION

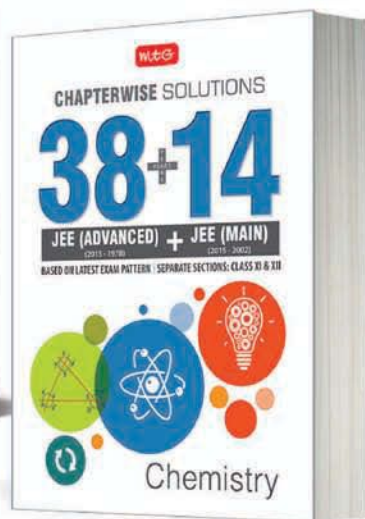
Packing refers to the arrangement of constituent units in such a way that the forces of attraction among the constituent particles have maximum



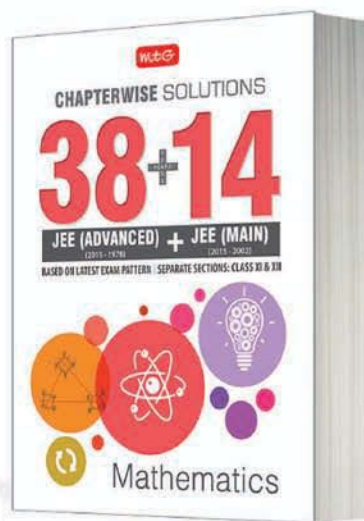
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available space. In three dimensions, there is hexagonal close packing, cubic close packing and body-centred close packing. Two common types of close packing are :

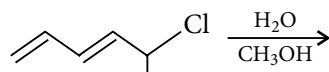
- (i) *ABABAB...* arrangement. This gives hexagonal close packing.
- (ii) *ABCABCABC...* arrangement. This gives cubical close packing.

7. A certain oxide of metal *M* crystallised in such a way that O^{2-} ions are in *hcp* arrangement. The metal ion however occupy $2/3^{rd}$ of the tetrahedral voids. The formula of the compound is
 (a) M_4O_3 (b) M_3O
 (c) $M_{8/3}O_3$ (d) MO_2
8. A solid has *bcc* structure. If the distance of closest approach between the two atoms is 1.73 \AA , the edge length of the cell is

- (a) 200 pm (b) $\frac{\sqrt{3}}{\sqrt{2}} \text{ pm}$
- (c) 142.2 pm (d) $\sqrt{2} \text{ pm}$

INTEGER VALUE

9. In the following reaction, the number of substituted alcohols formed is



10. If HCl is assumed to be completely polar then the expected value of dipole moment is 6.12 D but its experimental value is found to be 1.03 D. The percentage ionic character in HCl is $xy\%$ then the value of $x + y$ is

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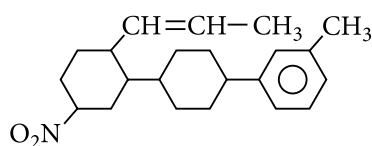
GO!!

EXAM ON
22ND
MAY

PAPER-I

SECTION-1

- This section contains EIGHT questions
 - The answer to each question is a SINGLE DIGIT INTEGER ranging from 0 to 9, both inclusive
- Solute A is a ternary electrolyte and solute B is a non-electrolyte. If 0.1 M solution of solute B produces an osmotic pressure of 2π then 0.05 M solution of A at the same temperature will produce osmotic pressure equal to $x\pi$. The value of x is
 - The number of stereocentres present in the given compound is



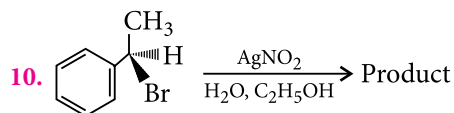
- The maximum number of carbon atoms arranged linearly in the following molecule is

$$\text{H}_3\text{C} - \text{C} \equiv \text{C} - \text{CH}_2 - \text{CH}_3$$
- A covalent molecule AB_3 has pyramidal structure. The sum of numbers of lone pair and bond pair electrons in the molecule is
- The number of water molecules directly bonded to the metal centre in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ is
- The number of nodal planes present in σ^* s antibonding orbitals is
- The dissociation energy of H_2 is 430.53 kJ/mol. If H_2 is exposed to light energy of wavelength 253.7 nm, percentage of light energy converted to kinetic energy is
- Grams of potassium dichromate required to oxidise 24.82 g of Fe^{2+} in FeSO_4 to Fe^{3+} , if the reaction is carried out in an acidic solution is
 [At. wt. K=39 u, Cr=52 u, Fe=56 u, S=32 u, O=16 u]

SECTION-2

- This section contains TEN questions
- Each question has FOUR options (a), (b), (c) and (d). ONE OR MORE THAN ONE of these four option(s) is(are) correct

- In solid ammonia, each NH_3 molecule has six other NH_3 molecules as nearest neighbours. ΔH of sublimation of NH_3 at the melting point is 30.8 kJ mol^{-1} and the estimated ΔH of sublimation in the absence of hydrogen bonding is 14.4 kJ mol^{-1} . Strength of H-bond in solid NH_3 is approximately
 (a) 5.5 kJ mol^{-1} (b) 16.4 kJ mol^{-1}
 (c) 2.7 kJ mol^{-1} (d) -2.7 kJ mol^{-1}



The main product is

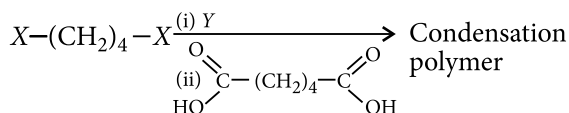
- (a) (b)
 (c) + Enantiomer
 (d) + Enantiomer

- Which of the following molecules contain(s) deuterium after reaction with NaOD in D_2O ?

- (a) $\text{C}_6\text{H}_5\text{CH}=\text{O}$ (b) $\text{C}_6\text{H}_5\text{C}(=\text{O})\text{C}(\text{CH}_3)_3$
 (c) $\text{C}_6\text{H}_5\text{CH}_2\text{CH}=\text{O}$
 (d) $\text{C}_6\text{H}_5\text{C}(=\text{O})\text{CH}(\text{CH}_3)_2$

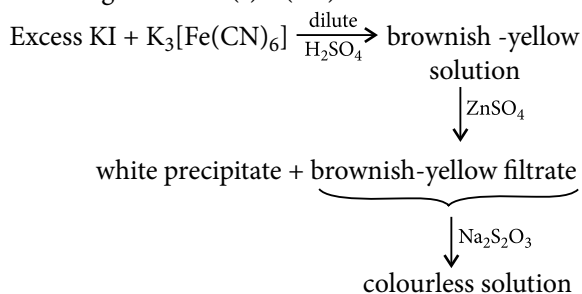
12. The reaction of propene with HOCl proceeds *via* the addition of
- H^+ in the first step
 - Cl^+ in the first step
 - OH^- in the first step
 - Cl^+ and OH^- in a single step.

13. The correct functional group X and the reagent/reaction conditions Y in the following scheme are



- $\text{X} = \text{COOCH}_3$, $\text{Y} = \text{H}_2/\text{Ni}/\text{heat}$
 - $\text{X} = \text{CONH}_2$, $\text{Y} = \text{H}_2/\text{Ni}/\text{heat}$
 - $\text{X} = \text{CONH}_2$, $\text{Y} = \text{Br}_2/\text{NaOH}$
 - $\text{X} = \text{CN}$, $\text{Y} = \text{H}_2/\text{Ni}/\text{heat}$.
14. Devise a series of reactions to convert ethyl 3-oxobutanoate to ethyl 4-oxopentanoate. Select reagents and conditions from the following table, listing them in the order of use :
- | | |
|-----------------------------------|---|
| (1) Sodium ethoxide in ethanol | (4) CO_2 ; then H_3O^+ |
| (2) Ethanol + Acid catalyst | (6) PBr_3 |
| (3) H_3O^+ ; heat | (8) CH_2I_2 in ether; $\text{Zn} - \text{Cu}$ |
| (5) Mg in ether | (10) $(\text{CH}_3\text{CO})_2\text{O}$; Pyridine |
| (7) NaBH_4 in alcohol | |
- (9) $\text{BrCH}_2\text{COOC}_2\text{H}_5$ (10) $(\text{CH}_3\text{CO})_2\text{O}$; Pyridine
- 1, 9, 3, then 2
 - 7, 6, 5, 10, then 2
 - 3, 7, 6, 5, 10, then 2
 - 8, 3, then 2

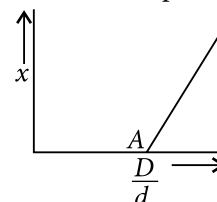
15. For the given aqueous reactions, which of the following statement(s) is(are) true?



- The first reaction is a redox reaction.
 - White precipitate is $\text{Zn}_3[\text{Fe}(\text{CN})_6]_2$.
 - Addition of filtrate to starch solution gives blue colour.
 - White precipitate is soluble in NaOH solution.
16. $(\text{Ag} + \text{Pb}) \text{ alloy} \xrightarrow[\text{is added}]{\text{melt and zinc}} (\text{Ag} + \text{Pb} + \text{Zn}) \text{ melt}$
- $$\xrightarrow[\text{Layer Y}]{\text{cool}} \text{Layer X}$$

Select the correct statement based on the above scheme :

- Layer X contains zinc and silver.
 - Layer Y contains lead and silver but amount of silver in this layer is smaller than in the layer X.
 - X and Y are immiscible layers.
 - All are correct statements.
17. In which of the following cases ($E_{\text{cell}} - E^\circ_{\text{cell}}$) is zero?
- $\text{Cu}|\text{Cu}^{2+}(0.01 \text{ M})||\text{Ag}^+(0.1 \text{ M})|\text{Ag}$
 - $\text{Pt}(\text{H}_2)|\text{pH} = 1||\text{Zn}^{2+}(0.01 \text{ M})|\text{Zn}$
 - $\text{Pt}(\text{H}_2)|\text{pH} = 1||\text{Zn}^{2+}(1 \text{ M})|\text{Zn}$
 - $\text{Pt}(\text{H}_2)|\text{H}^+(0.01 \text{ M})||\text{Zn}^{2+}(0.01 \text{ M})|\text{Zn}$
18. Before equilibrium is set-up for the chemical reaction, $\text{N}_2\text{O}_4 \rightleftharpoons 2\text{NO}_2$, vapour density of the gaseous mixture was measured. If D is the theoretical value of vapour density, variation of x with D/d is shown by the following graph.



- (a) 0 (b) 1.5 (c) 1 (d) 0.5

SECTION-3

- This section contains TWO questions
- Each question contains two columns, Column I and Column II
- Column I has four entries (A), (B), (C) and (D).
- Column II has four entries (P), (Q), (R) and (S).
- Match the entries in Column I with the entries in Column II
- One or more entries in Column I may match with one or more entries in Column II

19. Match the appropriate metals in Column I with the extraction processes in Column II.

Column I	Column II
(A) Silver	(P) Fused salt electrolysis
(B) Calcium	(Q) Carbon reduction
(C) Zinc	(R) Carbon monoxide reduction
(D) Iron	(S) Amalgamation

20. Match the expressions in Column I with the variables in Column II.

Column I	Column II
(A) $(\partial G/\partial P)_T$	(P) μ_{JT}
(B) $(\partial G/\partial T)_P$	(Q) T
(C) $(\partial H/\partial S)_P$	(R) $-S$
(D) $(\partial T/\partial P)_H$	(S) V

PAPER-2

SECTION-1

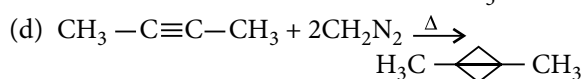
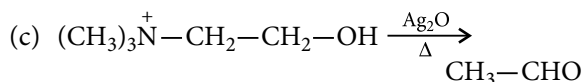
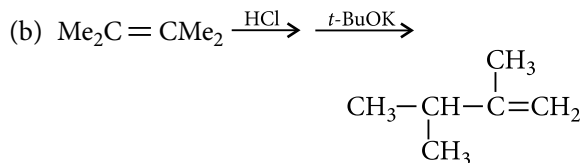
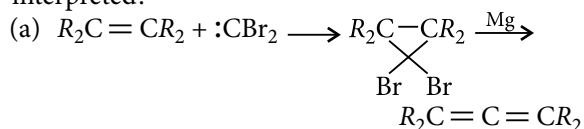
- This section contains EIGHT questions
 - The answer to each question is a SINGLE DIGIT INTEGER ranging from 0 to 9, both inclusive
1. The number of moles of KMnO_4 reduced by one mole of KI in alkaline medium is
 2. 0.28 g of an organic compound was heated with conc. H_2SO_4 and then distilled with NaOH to produce NH_3 . NH_3 gas is passed through 50 mL $\frac{N}{10}$ H_2SO_4 . Remaining acid required 40 mL $\frac{N}{10}$ alkali for complete neutralisation. The percentage of nitrogen in the compound is
 3. A compound $\text{A}(\text{C}_5\text{H}_8\text{O}_2)$ is reduced to pentane with Zn-Hg/HCl . It forms a dioxime with NH_2OH and also gives positive iodoform and Tollens' tests. The number of ketonic groups present in A is
 4. In the complex with formula $\text{MCl}_3 \cdot 4\text{H}_2\text{O}$, the coordination number of the metal M is six and there is no molecule of hydration in it. The volume of 1 M AgNO_3 solution needed to precipitate the free chloride ions in 200 mL of 0.01 M solution of the complex is
 5. A weak field complex of Ni^{2+} has magnetic moment value of 2.82 B.M. The number of electrons in the t_{2g} level of Ni^{2+} is
 6. 2 g atom of aluminium is treated separately with excess of dil. H_2SO_4 and excess of NaOH , the sum of the simplest ratio of volumes of hydrogen evolved is
 7. The dissociation constant of a substituted benzoic acid at 25°C is 1.0×10^{-4} . The pH of a 0.01 M solution of its sodium salt is
 8. Total number of α - and β -particles emitted for the natural $(4n + 1)$ series conversion of ${}_{94}\text{Pu}^{241}$ to ${}_{92}\text{U}^{233}$ is

SECTION-2

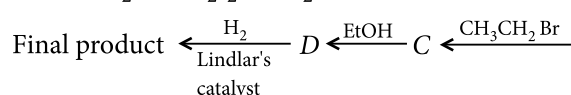
- This section contains EIGHT questions
 - Each question has FOUR options (a), (b), (c) and (d). ONE OR MORE THAN ONE of these four option(s) is(are) correct
9. For two gases, A and B with molecular weights M_A and M_B , it is observed that at a certain temperature T, the mean velocity of A is equal to the u_{rms} of B. Thus, the mean velocity of A can be made equal to the mean velocity of B, if
 - (a) A is at temperature T and B at T' ; $T > T'$
 - (b) both A and B are raised to a higher temperature

- (c) both A and B are lowered in temperature
- (d) none of these.

10. Which of the following reactions are properly interpreted?

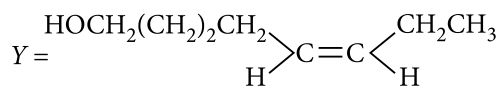
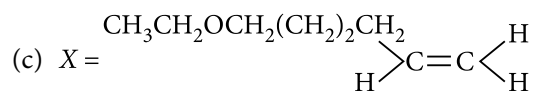
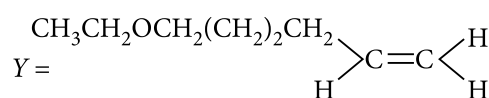
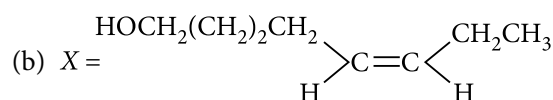


11. $\text{HO}-\text{CH}_2-(\text{CH}_2)_2-\text{CH}_2-\text{C}\equiv\text{CH}$ (A) $\xrightarrow{\text{NaNH}_2} \text{B}$

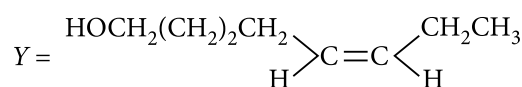


If A is treated with excess of NaNH_2 , the final product is X and if A is treated with only one equivalent of NaNH_2 , the final product is Y. (Remaining reagents are reacted as indicated in both the cases). Which of the following justify X and Y correctly?

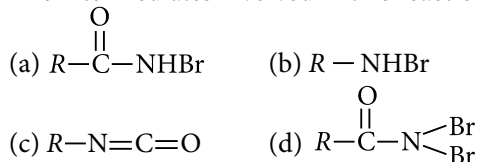
- (a) X and Y both are same molecules but X will be in higher yield.



- (d) $\text{X} = \text{HOCH}_2(\text{CH}_2)_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}=\text{CH}_2$



12. Reaction of $R-\overset{\overset{\text{O}}{\parallel}}{\text{C}}-\text{NH}_2$ with a mixture of Br_2 and KOH gives $R-\text{NH}_2$ as the main product. The intermediates involved in this reaction are



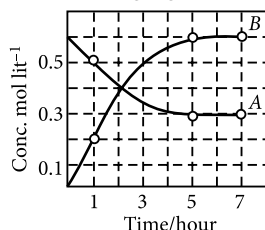
13. Among Al_2O_3 , SiO_2 , P_2O_3 and SO_2 , the correct order of acid strength is
 (a) $\text{SO}_2 < \text{P}_2\text{O}_3 < \text{SiO}_2 < \text{Al}_2\text{O}_3$
 (b) $\text{SiO}_2 < \text{SO}_2 < \text{Al}_2\text{O}_3 < \text{P}_2\text{O}_3$
 (c) $\text{Al}_2\text{O}_3 < \text{SiO}_2 < \text{SO}_2 < \text{P}_2\text{O}_3$
 (d) $\text{Al}_2\text{O}_3 < \text{SiO}_2 < \text{P}_2\text{O}_3 < \text{SO}_2$
14. Compound (A) $\text{C}_8\text{H}_{10}\text{O}$ reacts with sodium to give colourless and odourless gas and upon vigorous oxidation using KMnO_4 gives terephthalic acid, the compound contains
 (a) phenolic $-\text{OH}$ (b) benzene ring
 (c) alkyl group substituted at *meta*-position
 (d) alkyl group substituted at *para*-position.
15. In compounds of type ECl_3 , where $\text{E} = \text{B}, \text{P}, \text{As}$ or Bi , the angles $\text{Cl}-\text{E}-\text{Cl}$ for different E are in the order
 (a) $\text{B} > \text{P} = \text{As} = \text{Bi}$ (b) $\text{B} > \text{P} > \text{As} > \text{Bi}$
 (c) $\text{B} < \text{P} = \text{As} = \text{Bi}$ (d) $\text{B} < \text{P} < \text{As} < \text{Bi}$
16. Among the following species, the isostructural pairs are NF_3 , NO_3^- , BF_3 , H_3O^+ , HN_3
 (a) $[\text{NF}_3, \text{NO}_3^-]$ and $[\text{BF}_3, \text{H}_3\text{O}^+]$
 (b) $[\text{NF}_3, \text{HN}_3]$ and $[\text{NO}_3^-, \text{BF}_3]$
 (c) $[\text{NF}_3, \text{H}_3\text{O}^+]$ and $[\text{NO}_3^-, \text{BF}_3]$
 (d) $[\text{NF}_3, \text{H}_3\text{O}^+]$ and $[\text{HN}_3, \text{BF}_3]$

SECTION-3

- This section contains TWO paragraphs
- Based on each paragraph, there will be TWO questions
- Each question has FOUR options (a), (b), (c) and (d). ONE OR MORE THAN ONE of these four option(s) is(are) correct

PARAGRAPH 1

The progress of the reaction, $\text{A} \rightleftharpoons \text{nB}$ with time is represented in the following figure :



17. What is the value of n ?
 (a) 1 (b) 2 (c) 3 (d) 4
18. Find the value of the equilibrium constant.
 (a) 0.6 M (b) 1.2 M (c) 0.3 M (d) 2.4 M

PARAGRAPH 2

When Grignard reagent is treated with water, alcohol, ammonia, 1° amine, 2° amine, 1-alkyne or carboxylic acid, we get alkane corresponding to alkyl part of Grignard reagent. In Grignard reagent, C-atom is more electronegative than magnesium hence, its alkyl part acts as nucleophile and thus it will take an active hydrogen atom (H-atom that undergoes acylation) or acidic hydrogen atom to give its corresponding alkane. Also, it is known that stronger acid displaces weak acid from weak acid salt.

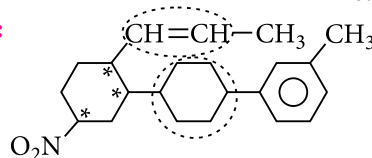
19. Structure of hydrocarbon, 0.34 g of which when treated with CH_3MgI liberates 112 mL of CH_4 at STP, will be
 (a) $\text{CH}_3\text{CH}(\text{CH}_3)-\text{C}\equiv\text{C}-\text{H}$ (b) $\text{CH}_3-\text{C}\equiv\text{C}-\text{H}$
 (c) $\text{CH}_3-\text{CH}_2-\text{C}\equiv\text{C}-\text{H}$
 (d) $\text{CH}_3-\text{CH}_2-\text{CH}(\text{CH}_3)-\text{C}\equiv\text{C}-\text{H}$
20. Molecular formula of the alcohol, 0.44 g of which when treated with CH_3MgI liberates 112 mL of CH_4 is
 (a) $\text{C}_5\text{H}_9\text{OH}$ (b) $\text{C}_4\text{H}_9\text{OH}$
 (c) $\text{C}_6\text{H}_{13}\text{OH}$ (d) $\text{C}_5\text{H}_{11}\text{OH}$

SOLUTIONS

PAPER-I

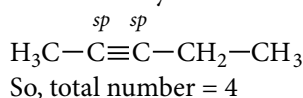
1. (3): $0.05 \text{ M solution of A} \rightarrow 0.05 \times 3 \text{ M ion} = 0.15 \text{ M}$
 $0.1 \text{ M solution of B has osmotic pressure} = 2\pi$
 $0.15 \text{ M solution will have osmotic pressure}$
 $= \frac{2\pi}{0.1} \times 0.15 = 3\pi$

2. (5):

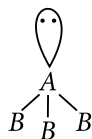


Asterisk carbons represent chiral carbons which will show apical isomerism while carbons in the dotted region will show geometrical isomerism.

3. (4): sp -hybridised carbon atoms as well as carbon atoms directly attached to it are linearly arranged.



4. (4): In general, a compound with formula AB_3 is sp^2 -hybridised with triangular planar geometry. However, the given compound has pyramidal structure which is possible only when it has a lone pair of electrons. Thus, AB_3 has three bond pairs and one lone pair.

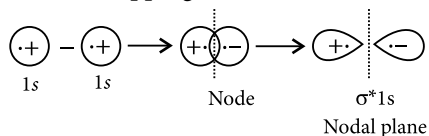


$$\text{Sum} = 3 + 1 = 4$$

5. (4): Hydrated copper sulphate or $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ is blue in colour and this colour is attributed to the presence of hydrated Cu(II) ion, i.e., $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$. Thus, the number of water molecules directly attached to Cu^{2+} or present within the coordination sphere is 4.

$\therefore \text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ can be written as $[\text{Cu}(\text{H}_2\text{O})_4]\text{SO}_4 \cdot \text{H}_2\text{O}$.

6. (1): The molecular orbital σ^* s is formed by the subtractive overlapping of two s -orbitals.



7. (9): Energy associated with H_2 molecule

corresponding to wavelength $253.7 \text{ nm} = \frac{hc}{\lambda}$

$$= \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{253.7 \times 10^{-9}} = 7.84 \times 10^{-19} \text{ J}$$

$$= 7.84 \times 10^{-19} \times 6.02 \times 10^{23} \text{ J/mol}$$

$$= 472 \times 10^3 \text{ J/mol}$$

% of light energy consumed

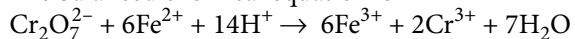
$$= \frac{430.53 \times 10^3}{472 \times 10^3} \times 100 = 91.2\%$$

Fraction of light energy converted into K.E.

$$= 8.8\% \approx 9\%$$

8. (8): When dissolved in water, $\text{K}_2\text{Cr}_2\text{O}_7$ dissociates into K^+ and $\text{Cr}_2\text{O}_7^{2-}$ ions and FeSO_4 dissociates into Fe^{2+} and SO_4^{2-} ions. The skeleton equation is:
 $\text{Fe}^{2+} + \text{Cr}_2\text{O}_7^{2-} \rightarrow \text{Fe}^{3+} + 2\text{Cr}^{3+}$

The balanced chemical equation is



From the balanced chemical equation, it is clear that

1 mol $\text{K}_2\text{Cr}_2\text{O}_7 \equiv 6 \text{ mol FeSO}_4$

Formula weight of $\text{K}_2\text{Cr}_2\text{O}_7 = 2 \times 39 + 2 \times 52 + 7 \times 16$
 $= 294 \text{ g mol}^{-1}$

Formula weight of $\text{FeSO}_4 = 152 \text{ g mol}^{-1}$

1 mol $\text{K}_2\text{Cr}_2\text{O}_7 \equiv 6 \text{ mol FeSO}_4$

$$1 \times 294 \quad 6 \times 152$$

$6 \times 152 \text{ g FeSO}_4$ require $\text{K}_2\text{Cr}_2\text{O}_7 = 294 \text{ g}$

24.82 g of FeSO_4 will require $\text{K}_2\text{Cr}_2\text{O}_7$

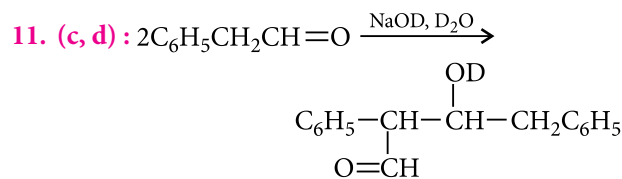
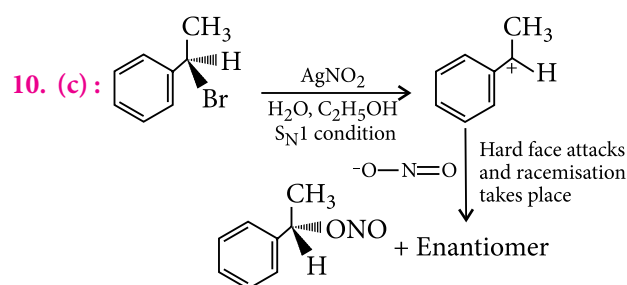
$$= \frac{294}{6 \times 152} \times 24.82 \text{ g} = 8 \text{ g}$$

9. (a): Total strength of all hydrogen bonds
 $= 30.8 - 14.4 = 16.4 \text{ kJ mol}^{-1}$

There are six nearest neighbours, but each hydrogen bond involves 2 molecules.

\therefore Effective neighbours = 3

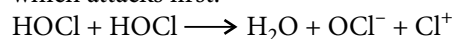
Hence, strength of H-bond $= \frac{16.4}{3} = 5.5 \text{ kJ mol}^{-1}$



The reactions occurs similarly with

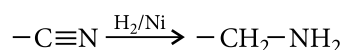
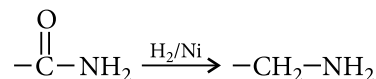
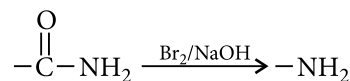
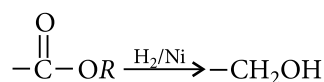


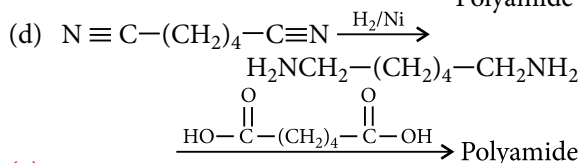
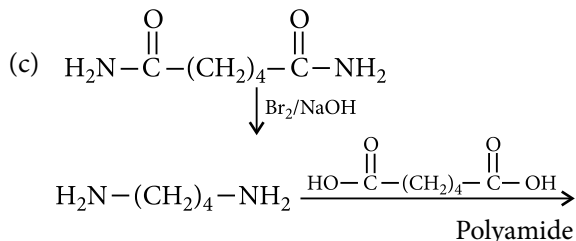
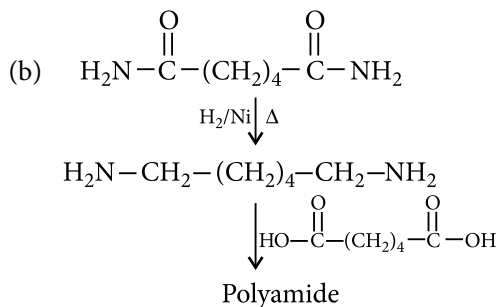
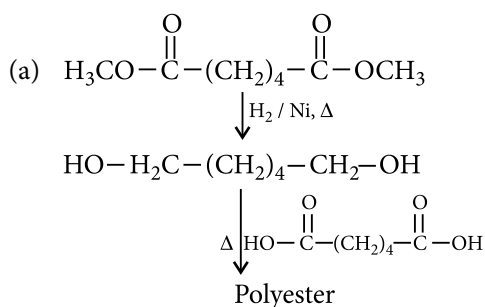
12. (b): Alkenes undergo electrophilic addition reactions. HOCl on self-ionisation produces Cl^+ which attacks first.



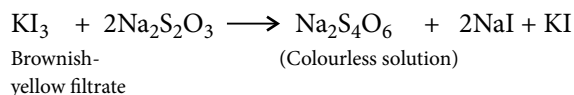
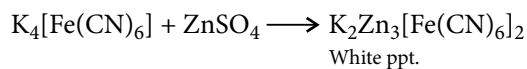
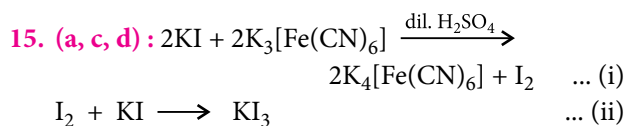
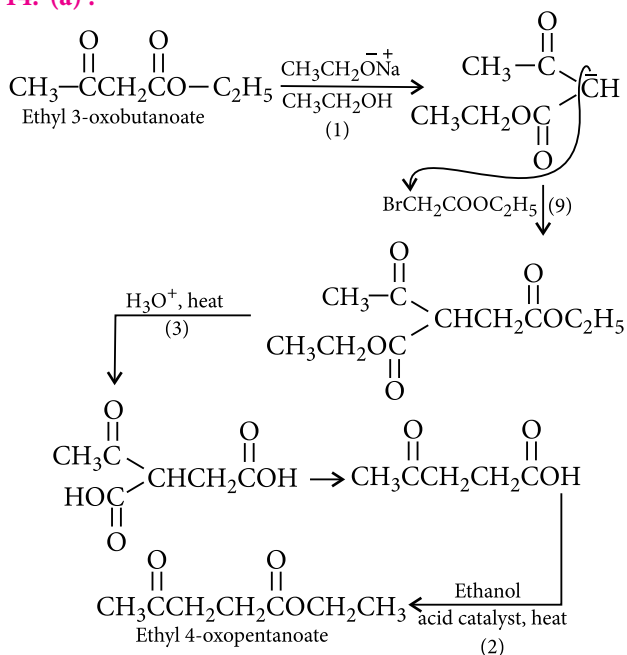
13. (a, b, c, d): Condensation polymers are formed by condensation of diols or diamines with dicarboxylic acids. Therefore,

X may be; $-\text{C}(=\text{O})-\text{OR}$ or $-\text{C}(=\text{O})-\text{NH}_2$ or $-\text{C}\equiv\text{N}$





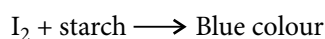
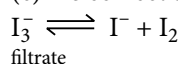
14. (a) :



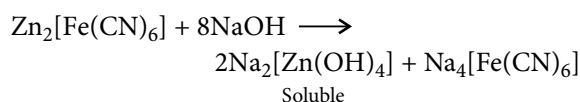
(a) is correct as in reaction (i), $\text{I}^- (-1)$ is being oxidised to $\text{I}_2(0)$ and Fe^{3+} is being reduced to Fe^{2+} .

(b) is incorrect as white precipitate is of $\text{K}_2\text{Zn}_3[\text{Fe}(\text{CN})_6]_2$ or $\text{Zn}_2[\text{Fe}(\text{CN})_6]$

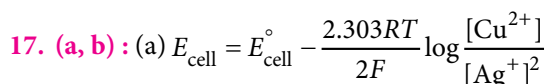
(c) is correct as



(d) is correct as white precipitate of $\text{K}_2\text{Zn}_3[\text{Fe}(\text{CN})_6]_2$ or $\text{Zn}_2[\text{Fe}(\text{CN})_6]$ is soluble in NaOH as



16. (d) : Zinc and lead in molten state are immiscible and form separate layers, zinc being lighter forms upper layer. Ag is soluble in both.



$$E_{\text{cell}} - E_{\text{cell}}^\circ = -\frac{2.303RT}{2F} \log \frac{0.01}{(0.1)^2}$$

$$E_{\text{cell}} - E_{\text{cell}}^\circ = 0$$

(b)
$$E_{\text{cell}} - E_{\text{cell}}^\circ = -\frac{2.303RT}{2F} \log \frac{[\text{H}^+]^2}{[\text{Zn}^{2+}]}$$

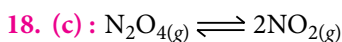
$$= -\frac{2.303RT}{2F} \log \frac{(1 \times 10^{-1})^2}{(0.01)} = 0$$

(c)
$$E_{\text{cell}} - E_{\text{cell}}^\circ = -\frac{2.303RT}{2F} \log \frac{[\text{H}^+]^2}{[\text{Zn}^{2+}]}$$

$$= -\frac{2.303RT}{2F} \log \frac{(1 \times 10^{-1})^2}{1} \neq 0$$

(d)
$$E_{\text{cell}} - E_{\text{cell}}^\circ = -\frac{2.303RT}{2F} \log \frac{[\text{H}^+]^2}{[\text{Zn}^{2+}]}$$

$$= -\frac{2.303RT}{2F} \log \frac{(0.01)^2}{(0.01)} \neq 0$$



Degree of dissociation, $x = \frac{D-d}{d}$ or $x = \frac{D}{d} - 1$
At A, $x = 0$

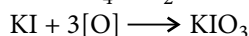
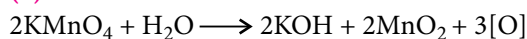
$\therefore \frac{D}{d} - 1 = 0$ or $\frac{D}{d} = 1$

19. A \rightarrow S; B \rightarrow P; C \rightarrow Q; D \rightarrow R

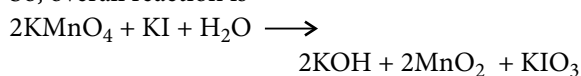
20. A \rightarrow S, B \rightarrow R, C \rightarrow Q, D \rightarrow P

PAPER-II

1. (2): In alkaline medium :



So, overall reaction is



2. (5): % age of nitrogen = $\frac{1.4}{W}(N_1V_1 - N_2V_2)$

$$= \frac{1.4}{0.28} \left(50 \times \frac{1}{10} - 40 \times \frac{1}{10} \right) = \frac{1.4}{0.28} (5 - 4)$$

$$= \frac{1.4 \times 1}{0.28} = 5\%$$

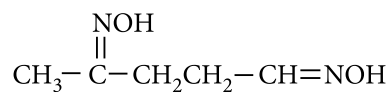
3. (1): (i) The compound gives positive iodoform test

indicating the presence of $\text{CH}_3-\overset{\text{O}}{\underset{\text{||}}{\text{C}}}-$ group.

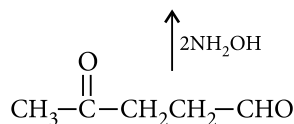
(ii) It also gives positive Tollens' test indicating the presence of $-\text{CHO}$ group.

(iii) The presence of one keto and one aldehydic group in the compound is indicated by its reaction with NH_2OH forming a dioxime.

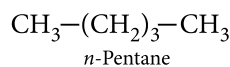
(iv) Both keto as well as aldehydic group can be reduced to hydrocarbon (alkane) through Clemmenson reduction.



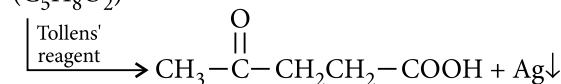
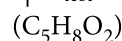
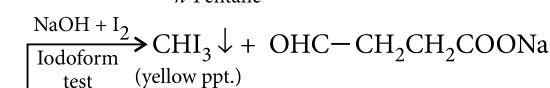
Dioxime



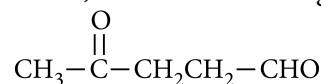
Clemmenson reduction \downarrow Zn(Hg)/HCl



n-Pentane



Hence, the structure of the given compound is



\therefore The number of ketonic groups is 1.

4. (2): The complex with formula $\text{MCl}_3 \cdot 4\text{H}_2\text{O}$, with no molecule of hydration is $[\text{MCl}_2(\text{H}_2\text{O})_4]\text{Cl}$, so, one chlorine is ionisable.

\therefore No. of equivalents of $\text{Ag}^+ = \text{No. of equivalents of } \text{Cl}^- \text{ in solution.}$

$$1 \times V = 200 \times 0.01 \therefore V = \frac{2}{1} = 2 \text{ mL}$$

ADMISSION NOTICE

Dr. A.P.J. Abdul Kalam Technical University Uttar Pradesh, Lucknow

(Formerly U.P. Technical University, Lucknow) U.P. State Entrance Examination (UPSEE- 2016)

Dr. A.P.J. Abdul Kalam Technical University Uttar Pradesh, Lucknow would conduct State Entrance Examination known as UPSEE- 2016.

A. 1st Year of B.Tech/ B. Tech. (Biotech)/B. Tech. (Ag)/ B. Arch./ B. Pharm./ B. HMCT/ B.FAD/ B.FA/ MBA/ MCA/ MAM (5 years Dual Degree)

B. Lateral Entry: Direct Admission to 2nd year of B.Tech/ B. Pharm/ MCA

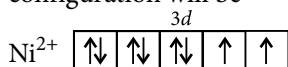
SCHEME OF ENTRANCE EXAMINATION

Date of Exam	Courses with Paper Code	Mode of Examination
April 17, 2016 (Sunday)	B.Tech (Paper- 1), B. Tech (Biotech) (Paper 1 or Paper 2), B.Tech. (Ag) (Paper 1/Paper 3), B.Arch. (Paper 4), B. Pharm. (Paper 1 or Paper 2)	OMR based Test
April 23, 2016 (Saturday)	B.HMCT/ B.FAD/ B.FA (Paper 5), Lateral Entry: Direct Admission to 2 nd year of B.Tech (Paper 6/ Paper 8), B.Pharm (Paper 7)	Computer Based Test
April 24, 2016 (Sunday)	MBA (Paper 9), MCA (Paper 10), MAM (5 years Dual Degree) (Paper 11), Lateral Entry: Direct Admission to 2 nd year MCA (Paper 12)	Computer Based Test

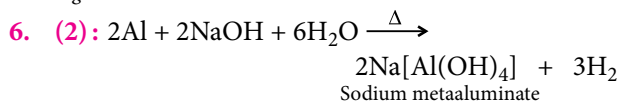
The application form can be filled ONLINE only through the website <http://www.upsee.nic.in>. The link for filling up the ONLINE Application Form will be opened from **February 24, 2016 at 11:00 AM**. The last date and time for filling up the Application Form is **March 27, 2016, 05:00 PM**.

5. (6) : $\mu = 2.82 = \sqrt{n(n+2)} \Rightarrow n = 2$

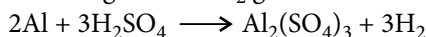
Since, Ni^{2+} has two unpaired electrons so, its configuration will be



In weak field complexes, first the t_{2g} and e_g levels are singly occupied and then the pairing of electrons in t_{2g} level takes place. Thus, there are 6 electrons in t_{2g} level.



Al dissolves in dil. HCl and dil. H_2SO_4 slowly liberating 3 moles H_2 gas.



Hence, the ratio of volumes of H_2 evolved is 1 : 1.

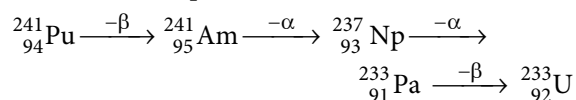
Sum of the ratio = 1 + 1 = 2.

7. (8): Given, $K_a = 1 \times 10^{-4}$
 $\therefore \text{p}K_a = -\log(1 \times 10^{-4}) = 4$
 $C = 0.01 \text{ M}$

Since the solution contains a salt of weak acid and strong base,

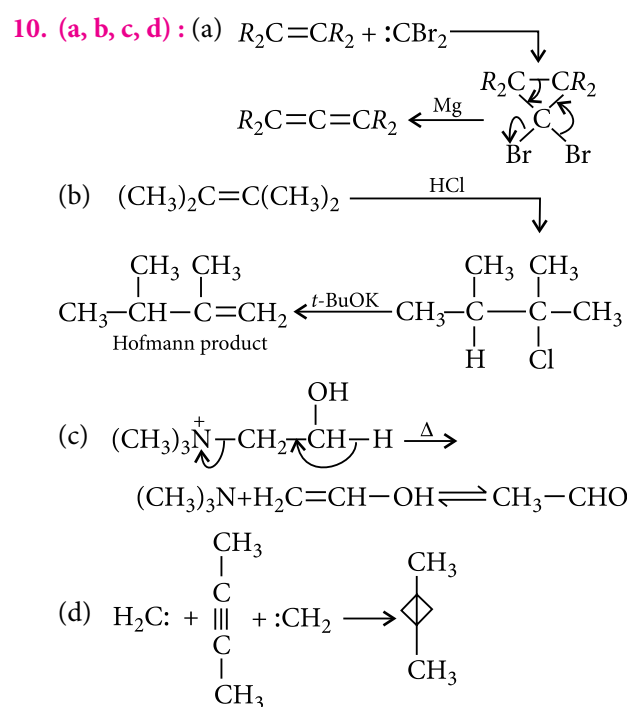
$\therefore \text{pH} = 7 + \frac{1}{2}\text{p}K_a + \frac{1}{2}\log C$
 $= 7 + \frac{1}{2} \times 4 + \frac{1}{2} \times \log(0.01) = 9 + \frac{1}{2} \times (-2) = 8$
 $\therefore \text{pH of solution} = 8.$

8. (4): $(4n + 1)$ Neptunium series

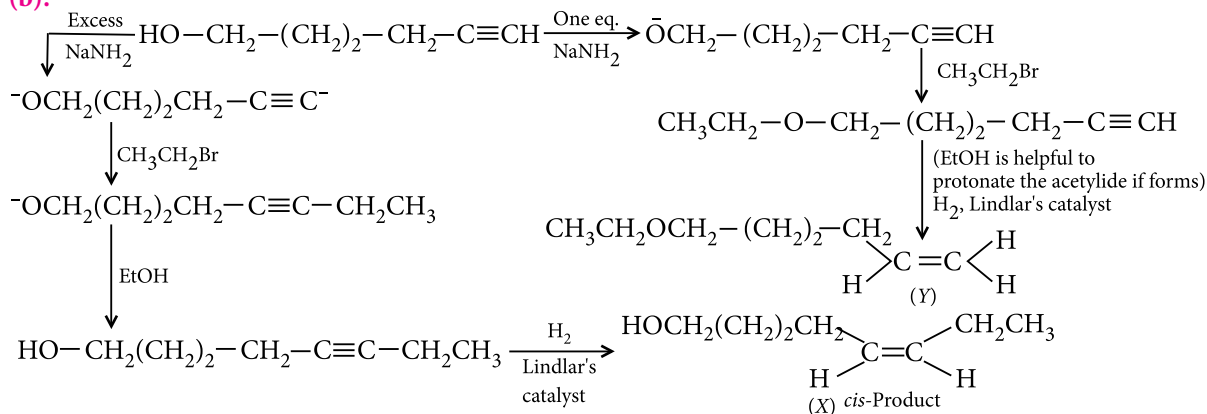


2α and 2β particles are emitted.

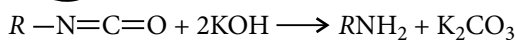
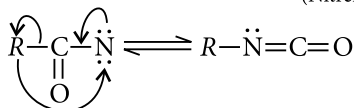
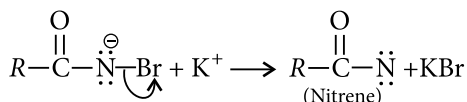
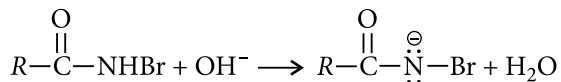
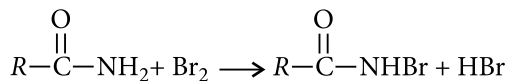
9. (d): $\sqrt{\frac{8RT}{\pi M_A}} = \sqrt{\frac{3RT}{M_B}}$
 $\frac{8}{\pi M_A} = \frac{3}{M_B} \Rightarrow \frac{M_A}{M_B} = \frac{8}{3\pi}$
for $\sqrt{\frac{8RT}{\pi M_A}} = \sqrt{\frac{8RT'}{\pi M_B}}$
 $\frac{T}{M_A} = \frac{T'}{M_B}; \frac{3\pi T}{8M_B} = \frac{T'}{M_B}$
 $\frac{T}{T'} = \frac{8}{3\pi} \quad T' > T$



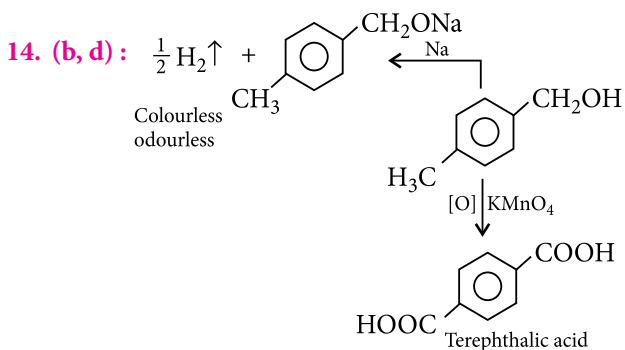
11. (b):



12. (a, c) : This is Hofmann bromamide degradation reaction.



13. (d) : Acidic strength of oxides in a period increases from left to right. Thus, the order of acidic strength is $\text{Al}_2\text{O}_3 < \text{SiO}_2 < \text{P}_2\text{O}_3 < \text{SO}_2$



15. (b) : In BCl_3 , the state of hybridisation,

$$H = \frac{1}{2} (3 + 3 + 0 - 0) = 3 \text{ i.e., } sp^2$$

So, the bond angle is 120° .

The state of hybridisation in case of P, As and Bi is sp^3 and due to the presence of a lone pair on the central atom the bond angle is less than normal tetrahedral angle of $109^\circ 28'$, i.e., bond angle $< 109^\circ 28'$. Since the central atom (P, As, Bi) belong to the same group, the bond angle of ECl_3 decreases as we go down the group, i.e., from P to As to Bi, thus the correct order of bond angles is $\text{BCl}_3 > \text{PCl}_3 > \text{AsCl}_3 > \text{BiCl}_3$.

16. (c) : Isostructural compounds have same type of hybridisation.

In NF_3 , N is sp^3 hybridised (3 b.p. + 1 l.p.)

In NO_3^- , N is sp^2 hybridised.

In BF_3 , B is sp^2 hybridised.

In H_3O^+ , O is sp^3 hybridised.

Thus, it can be concluded that NF_3 and H_3O^+ are isostructural and BF_3 and NO_3^- are isostructural.

17. (b) : According to the figure, in the given time of 4 hours (1 to 5) concentration of A falls from 0.5 to 0.3 M, while in the same time concentration of B increases from 0.2 to 0.6 M.

Decrease in concentration of A in 4 hours

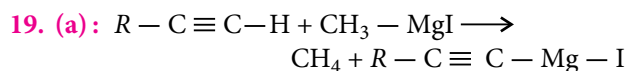
$$= 0.5 - 0.3 = 0.2 \text{ M}$$

Increase in concentration of B in 4 hours

$$= 0.6 - 0.2 = 0.4 \text{ M}$$

Thus, increase in concentration of B in a given time is twice the decrease in concentration of A. Thus $n = 2$.

18. (b) : $K = \frac{[B]^2}{[A]} = \frac{(0.6)^2}{0.3} = 1.2 \text{ M}$



Number of moles of CH_4

= Number of moles of hydrocarbon

$$\frac{112}{22400} = \frac{0.34}{\text{Molar mass}} \Rightarrow \text{Molar mass} = 68$$

$$\text{C}_n\text{H}_{2n-2} = 68 \Rightarrow n = \frac{68+2}{14} = 5$$

Molecular formula of hydrocarbon,

$R-\text{C} \equiv \text{C}-\text{H}$ is C_5H_8

Hence, $R = \text{C}_3\text{H}_7$ which may be propyl or isopropyl.

20. (d) : Number of moles of alcohol

= Number of moles of CH_4

$$\frac{0.44}{\text{Molar mass}} = \frac{112}{22400} \Rightarrow \text{Molar mass} = 88$$

$$n = \frac{88-18}{14} = 5$$

\therefore Molecular formula of alcohol = $\text{C}_5\text{H}_{11}\text{OH}$

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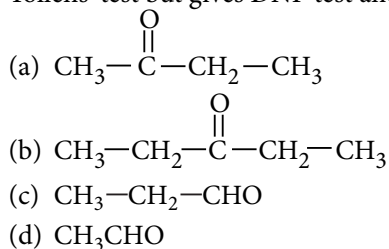
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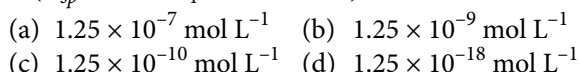
CLASS
XI-XII

*Dr. Sangeeta Khanna

1. Which of the following compounds does not give Tollens' test but gives DNP test and iodoform test?



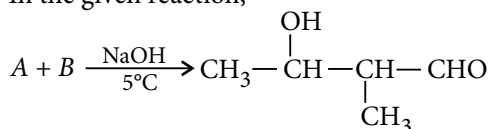
2. The solubility of PbSO_4 in 0.01 M Na_2SO_4 solution is (K_{sp} for $\text{PbSO}_4 = 1.25 \times 10^{-9}$)



3. At 25°C , the value of $\text{p}K_b$ (K_b being the dissociation constant of a base) for NH_3 in aqueous solution is 4.7. What is the pH of 0.1 M aqueous solution of NH_4Cl with 0.01 M NH_3 (approximately)?



4. In the given reaction,

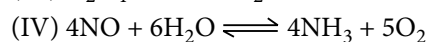
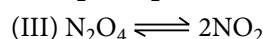
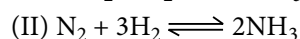
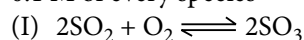


- (A) and (B) are respectively
 (a) $\text{CH}_3\text{CH}_2\text{CHO}$ and $\text{CH}_3-\text{CH}_2-\text{CHO}$
 (b) CH_3CHO and $\text{CH}_3-\text{CH}_2-\text{CHO}$
 (c) CH_3CHO and CH_3CHO
 (d) CH_3CHO and $\text{CH}_3-\overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}}-\text{CHO}$

5. $\text{CH}_3\text{COCH}_3(\text{g}) \rightleftharpoons \text{CH}_3\text{CH}_3(\text{g}) + \text{CO}(\text{g})$; When 1 mole of $\text{CH}_3\text{COCH}_3(\text{g})$ is taken, initial pressure of CH_3COCH_3 is 100 mm Hg. When equilibrium is set up mole fraction of $\text{CO}(\text{g})$ is $1/3$, hence K_p is

- (a) 100 mm Hg (b) 50 mm Hg
 (c) 25 mm Hg (d) 150 mm Hg

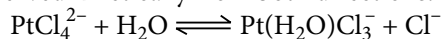
6. Consider the following reactions (in gaseous phase) in equilibrium with equilibrium concentrations 0.1 M of every species



Extent of reaction will be in order

- (a) $\text{I} = \text{II} \equiv \text{III} = \text{IV}$ (b) $\text{I} = \text{II} = \text{III} < \text{IV}$
 (c) $\text{III} < \text{I} = \text{IV} < \text{II}$ (d) $\text{IV} < \text{III} < \text{I} < \text{II}$

7. The approach of the following equilibrium was observed kinetically from both directions.

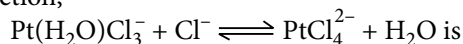


At 25°C , it is found

$$\frac{-d[\text{PtCl}_4^{2-}]}{dt} = (3.9 \times 10^{-5} \text{ s}^{-1}) [\text{PtCl}_4^{2-}]$$

$$- (2.1 \times 10^{-3} \text{ L mol}^{-1} \text{ s}^{-1}) [\text{Pt}(\text{H}_2\text{O})\text{Cl}_3^-] [\text{Cl}^-]$$

value of K_c when fourth Cl^- is complexed in the reaction,



- (a) $1.85 \times 10^{-2} \text{ mol L}^{-1}$ (b) $1.86 \times 2 \text{ mol L}^{-1}$
 (c) 53.85 mol L^{-1} (d) $8.19 \times 10^{-8} \text{ L mol}^{-1}$

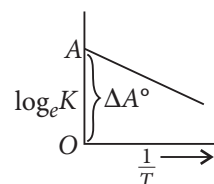
8. A graph between $\log_e K$ and $1/T$ is shown in the figure. Thus,

(a) $\Delta H^\circ > 0$ and $\Delta A^\circ = \frac{\Delta S^\circ}{R}$

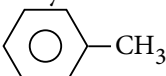
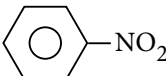
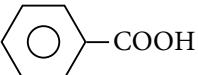
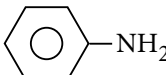

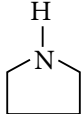
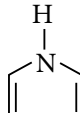
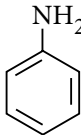

(b) $\Delta H^\circ < 0$ and $\Delta A^\circ = \frac{\Delta S^\circ}{R}$

(c) $\Delta H^\circ > 0$ and $\Delta A^\circ = -\frac{\Delta S^\circ}{R}$

(d) $\Delta H^\circ < 0$ and $\Delta A^\circ = -\frac{\Delta S^\circ}{R}$



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9. The xenon compound(s) that are isostructural with IBr_2^- and BrO_3^- respectively are
 (a) linear XeF_2 and pyramidal XeO_3
 (b) bent XeF_2 and pyramidal XeO_3
 (c) bent XeF_2 and planar XeO_3
 (d) linear XeF_2 and square planar XeO_3 .
10. The incorrect statement among the following is
 (a) $\text{La}(\text{OH})_3$ is less basic than $\text{Lu}(\text{OH})_3$
 (b) in lanthanide series, ionic radii of Ln^{3+} ion decrease
 (c) La is actually an element of transition series rather than lanthanide series
 (d) atomic radii of Zr and Hf are same because of lanthanide contraction.
11. The correct IUPAC name of $[\text{Pt}(\text{en})_2\text{Cl}(\text{ONO})]^{2+}$ is
 (a) chlorodiethylenediaminenitritoplatinum (IV) ion
 (b) bis(ethylenediamine)chloronitro-O-platinum (IV) ion
 (c) chloridobis(ethylenediamine)nitritoplatinum (IV) ion
 (d) chlorodiethylenediaminenitro-O-platinum (IV) ion.
12. Which of the following is the wrong statement regarding stability of coordination compounds?
 (a) Greater the charge on central metal, greater is the stability of the compound.
 (b) Chelation increases stability.
 (c) Conjugation and chelation always decrease stability.
 (d) Stability is a thermodynamic concept.
13. Sodium extract of which of the following compounds does not form blood red ppt. with aqueous FeCl_3 ?
 (a) NH_2NH_2 (b) $\text{NH}_2-\text{C}(=\text{O})-\text{NH}_2$
 (c) $\text{CH}_3-\text{CH}(\text{SH})-\text{CH}_2\text{NH}_2$ (d) Both (a) and (b)
14. Friedel Craft alkylation reaction is most easily shown by
 (a)  (b) 
 (c)  (d) 
15. The number of isomers of compound $\text{C}_2(\text{Br})(\text{F})(\text{I})(\text{Cl})$ is
 (a) 9 (b) 6 (c) 8 (d) 10
16. Which of the following saturated solutions will have the highest $[\text{OH}^-]$?
 (a) $\text{Al}(\text{OH})_3$; ($K_{sp} = 1.8 \times 10^{-32}$)
 (b) $\text{Fe}(\text{OH})_2$; ($K_{sp} = 1.6 \times 10^{-14}$)
 (c) $\text{Ca}(\text{OH})_2$; ($K_{sp} = 8.0 \times 10^{-6}$)
 (d) $\text{Mg}(\text{OH})_2$; ($K_{sp} = 1.2 \times 10^{-11}$)
17. Choose the incorrect match :
 (a) Cassiterite : SnO_2 (b) Galena : PbS
 (c) Cerussite : PbSO_4 (d) Corundum : Al_2O_3
18. Which is most basic out of the following?
- (a)  (b) 
 (c)  (d) 
19. Which of the following is correctly matched?
 (a)  $\xrightarrow[\text{CH}_3\text{COO}^-]{(\text{CH}_3\text{CO})_2\text{O}}$ (Perkin's reaction)
 (b) $2\text{HCHO} \xrightarrow{\text{NaOH}}$ (Aldol condensation)
 (c) $2\text{CH}_3\text{CHO} \xrightarrow{\text{NaOH}}$ (Cannizzaro reaction)
 (d) $\text{CH}_3-\text{CH}_2-\text{CHO} \xrightarrow{\text{I}_2 + \text{NaOH}}$ (Iodoform reaction)
20. How many electrons are present in 4th shell of Pd [At. No. = 46]?
 (a) 7 (b) 18 (c) 16 (d) 32
21. Most stable carbocation is
 (a) $p\text{-NO}_2-\text{C}_6\text{H}_4-\text{CH}_2^+$
 (b) $\text{C}_6\text{H}_5\text{CH}_2^+$
 (c) $p\text{-Cl}-\text{C}_6\text{H}_4-\text{CH}_2^+$
 (d) $p\text{-CH}_3\text{O}-\text{C}_6\text{H}_4-\text{CH}_2^+$
22. Heat of the following reaction in bomb calorimeter is - 1415 kJ.
 $\text{C}_2\text{H}_4(\text{g}) + 3\text{O}_2(\text{g}) \longrightarrow 2\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$
 What is the heat released if 1.4 g C_2H_4 is combusted in open atmosphere at 27°C?
 ($R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$)
 (a) -70.999 kJ (b) -1419.98 kJ
 (c) -709.99 kJ (d) -1415 kJ
23. For a cell reaction involving two electron change, the standard emf of the cell is found to be 0.295 V

at 25°C. The equilibrium constant of the reaction at 25°C will be

- (a) 10 (b) 1×10^{10}
(c) 1×10^{-10} (d) 29.5×10^{-2}

24. For the reaction, $\text{PCl}_{3(g)} + \text{Cl}_{2(g)} \rightleftharpoons \text{PCl}_{5(g)}$

at 27°C, K_p is 0.41 atm^{-1} . K_c will be

- (a) 6 L mol^{-1} (b) 60 L mol^{-1}
(c) 10.08 L mol^{-1} (d) $1.008 \times 10^2 \text{ L mol}^{-1}$

25. $\text{Ag}^+ + 2\text{NH}_3 \rightleftharpoons \text{Ag}(\text{NH}_3)_2^+$; $K_1 = 1.8 \times 10^7$

$\text{Ag}^+ + \text{Cl}^- \rightleftharpoons \text{AgCl}$; $K_2 = 5.6 \times 10^9$

$\text{AgCl} + 2\text{NH}_3 \rightleftharpoons \text{Ag}(\text{NH}_3)_2^+ + \text{Cl}^-$; $K = ?$

- (a) $(1.8 \times 10^7) \times (5.6 \times 10^9)$
(b) $(1.8 \times 10^7) + (5.6 \times 10^9)$
(c) $(1.8 \times 10^7) \div (5.6 \times 10^9)$
(d) $(1.8 \times 10^9) \div (5.6 \times 10^7)$

26. A solution of pH = 5 is diluted to 100 times. The pH of new solution is

- (a) 7 (b) 3 (c) 6.7 (d) 7.7

27. If the freezing point of a 0.01 molal aqueous solution of a cobalt(III) chloride-ammonia complex (which behaves as a strong electrolyte) is -0.0558°C , formula of complex is

[K_f of water = $1.86 \text{ K kg mol}^{-1}$]

- (a) $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$ (b) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$
(c) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$ (d) $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$

28. Copper is purified by electrolytic refining of blister copper. The incorrect statement(s) about this process is

- (a) impure Cu strip is used as cathode
(b) acidified aqueous CuSO_4 is used as electrolyte
(c) pure Cu is deposited at cathode
(d) impurities settle as anode-mud.

29. When freezing of a liquid takes place in a system

- (a) $q > 0$ or $q < 0$ depending on the liquid
(b) $q > 0$
(c) $q < 0$ (d) $q = 0$

30. A gas is allowed to expand reversibly under adiabatic conditions. What is zero for such a process?

- (a) ΔG (b) ΔT
(c) ΔS (d) W

31. Which of the following statements is incorrect?

- (a) Anhydrous aluminium chloride cannot be prepared by heating $\text{AlCl}_3 \cdot 6\text{H}_2\text{O}$ because of hydrolysis of AlCl_3 into $\text{Al}(\text{OH})_3$.
(b) AlCl_3 is a high-melting solid while AlF_3 is a low-melting volatile solid.

(c) Aluminium forms $[\text{AlF}_6]^{3-}$ ion but boron does not form $[\text{BF}_6]^{3-}$.

(d) Cryolite is added to alumina to lower the fusion temperature and to make the mass a good conductor of electricity.

32. In solid state, the $\text{B}(\text{OH})_3$ units are

- (a) linked by hydrogen bonds, and form three-dimensional sheets with almost trigonal symmetry
(b) linked by hydrogen bonds, and form two-dimensional sheets with almost hexagonal symmetry
(c) very close to each other and are tightly held, and so the crystals cannot be broken easily into fine particles
(d) linked by hydrogen bonds intramolecularly, and exist as discrete particles.

33. Following statements regarding the periodic trends of chemical reactivity of the alkali metals and the halogens are given. Which of these statements gives the correct picture?

- (a) In alkali metals the reactivity increases but it decreases in the halogens with increase in atomic number down the group.
(b) The reactivity decreases in the alkali metals but increases in the halogens with increase in atomic number down the group.
(c) In both the alkali metals and the halogens the chemical reactivity decreases with increase in atomic number down the group.
(d) Chemical reactivity increases with increase in atomic number down the group in both the alkali metals and halogens.

34. Which of the following is a correct order as indicated?

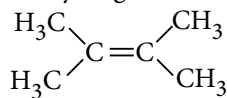
(a) $(\text{CH}_3)_3\text{N} > (\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2$ (Basic strength in aqueous solution)

(b) $\text{HCHO} > \text{C}_6\text{H}_5\text{CHO} > \text{CH}_3\text{COCH}_3$
(Nucleophilic addition reaction)

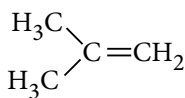
(c) $\text{C}_6\text{H}_5\text{CH}_2 > \text{p-Cl-C}_6\text{H}_4\text{CH}_2 > \text{p-CH}_3\text{C}_6\text{H}_4\text{CH}_2$
(Stability)

(d) $\text{CH}_3\text{—}\overset{\text{CH}_3}{\underset{+}{\text{C}}}\text{—CH}_2\text{—NO}_2 > \overset{+}{\text{C}}\text{F}_3 > \overset{+}{\text{C}}\text{H}_2\text{—CF}_3$
(Stability)

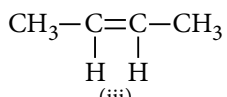
35. Which of the following is a correct order of reactivity for hydrogenation?



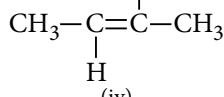
(i)



(ii)



(iii)

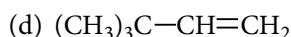
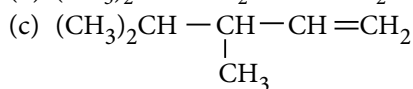
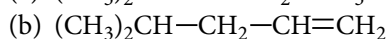
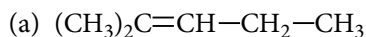


(iv)

- (a) i > ii > iii > iv (b) i > ii > iv > iii

- (c) iii > iv > ii > i (d) iv > iii > ii > i

36. 2,3-Dimethyl-2-butene can be prepared by heating which of the following compounds with a strong acid?



37. The number of structural isomers possible from the molecular formula $\text{C}_3\text{H}_9\text{N}$ is

(a) 2

(b) 3

(c) 4

(d) 5

38. Strong reducing behaviour of H_3PO_2 is due to

(a) high oxidation state of phosphorus

(b) presence of two $-\text{OH}$ groups and one $\text{P}-\text{H}$ bond

(c) presence of one $-\text{OH}$ group and two $\text{P}-\text{H}$ bonds

(d) high electron gain enthalpy of phosphorus.

39. In which of the following pairs, both the species have same hybridisation?

(a) NH_3 , PH_3

(b) XeF_4 , XeO_4

(c) SiCl_4 , PCl_5

(d) diamond, graphite

40. Assuming complete ionisation, same moles of which of the following compounds will require the least amount of acidified KMnO_4 for complete oxidation?

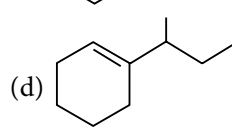
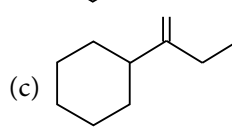
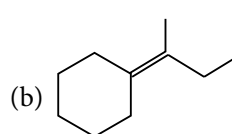
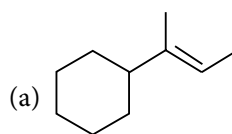
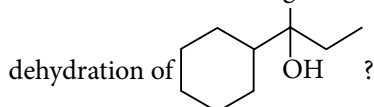
(a) FeC_2O_4

(b) $\text{Fe}(\text{NO}_2)_2$

(c) FeSO_4

(d) FeSO_3

41. Which of the following is not the product of



42. Which is the correct order of increasing energy of the listed orbitals in the atom of titanium?

(At. no. $Z = 22$)

(a) $3s \ 3p \ 3d \ 4s$

(b) $3s \ 3p \ 4s \ 3d$

(c) $3s \ 4s \ 3p \ 3d$

(d) $4s \ 3s \ 3p \ 3d$

43. In the extraction of copper from its sulphide ore, the metal is finally obtained by the reduction of cuprous oxide with

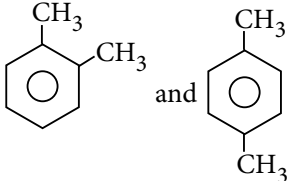
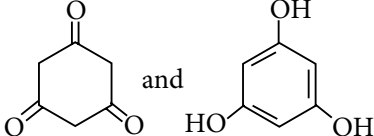
(a) copper(I) sulphide

(b) sulphur dioxide

(c) iron(II) sulphide

(d) carbon monoxide.

44. Match list-I and List-II and select the correct answer from the codes given below the lists :

	List-I	List-II
A.	$\text{CH}_3-\overset{\text{O}}{\underset{\text{O}}{\text{C}}}-\underset{\text{CH}_3}{\text{CH}}-\text{CH}_3$ and $\text{CH}_3-\overset{\text{O}}{\text{C}}-\text{CH}_2\text{CH}_2\text{CH}_3$	1. Positional isomer
B.		2. Chain isomer
C.		3. Enantiomer
D.	$\text{H}-\underset{\text{CH}_3}{\overset{\text{CHO}}{\text{C}}}-\text{OH}$ and $\text{H}-\underset{\text{CH}_3}{\overset{\text{OH}}{\text{C}}}-\text{CHO}$	4. Tautomer

A B C D

(a) 1 2 3 4

(b) 2 1 4 3

(c) 1 2 4 3

(d) 2 1 3 4

45. Match the List-I with List-II and select the correct answer from the codes given below the lists :

List-I		List-II	
A.	Constitutional isomers	1.	Stereoisomers that are mirror images
B.	Stereoisomers	2.	Isomers that differ in the order in which their atoms are connected
C.	Enantiomers	3.	Isomers that have same constitution but differ in the arrangement of their atoms in space
D.	Diastereomers	4.	Stereoisomers which are not mirror image

- A B C D
 (a) 1 2 4 3
 (b) 2 3 1 4
 (c) 4 3 1 2
 (d) 2 3 4 1

ANSWER KEYS

1. (a) 2. (a) 3. (a) 4. (b) 5. (b)
 6. (c) 7. (c) 8. (b) 9. (a) 10. (a)
 11. (c) 12. (c) 13. (d) 14. (a) 15. (b)
 16. (c) 17. (c) 18. (b) 19. (a) 20. (b)
 21. (d) 22. (a) 23. (b) 24. (c) 25. (c)
 26. (c) 27. (a) 28. (a) 29. (c) 30. (c)
 31. (b) 32. (b) 33. (a) 34. (b) 35. (c)
 36. (d) 37. (c) 38. (c) 39. (a) 40. (c)
 41. (d) 42. (b) 43. (a) 44. (b) 45. (b)

SOLUTIONS

1. (a)
 2. (a): $\text{PbSO}_4 \rightleftharpoons \text{Pb}^{2+} + \text{SO}_4^{2-}$
 $s \quad s + 0.01$
 $1.25 \times 10^{-9} = s(s + 0.01)$
 3. (a): $\text{pOH} = \text{p}K_b + \log_{10} \frac{[\text{NH}_4\text{Cl}]}{[\text{NH}_4\text{OH}]}$
 $= 4.7 + \log \left[\frac{0.1}{0.01} \right] = 5.7; \text{pH} = 14 - 5.7 = 8.3$
 4. (b)
 5. (b): $\text{CH}_3\text{COCH}_3(\text{g}) \rightleftharpoons \text{CH}_3\text{CH}_3(\text{g}) + \text{CO}(\text{g})$
 Initial : 1 0 0
 At eq. : (1 - x) x x
 Total moles at equilibrium : (1 + x)
 $X_{\text{CO}} = \frac{x}{1+x} = \frac{1}{3} \therefore x = 0.5$
 \therefore Total moles at equilibrium = 1.5

\therefore Initial pressure = 100 mm

$$\frac{P_1}{n_1} = \frac{P_2}{n_2}$$

$$\frac{100}{1} = \frac{P_2}{1.5}$$

\therefore Equilibrium pressure = 150 mm

$$p_{\text{CO}} = 50 \text{ mm}$$

$$p_{\text{CH}_3\text{CH}_3} = 50 \text{ mm}$$

$$p_{\text{CH}_3\text{COCH}_3} = 50 \text{ mm}$$

$$K_p = \frac{p_{\text{CH}_3\text{CH}_3} \cdot p_{\text{CO}}}{p_{\text{CH}_3\text{COCH}_3}} = 50 \text{ mm Hg}$$

6. (c) : Equilibrium concentration is 0.1 M in each case. Greater the value of K_c , greater is the extent of reaction.

7. (c) : For the given reaction

$$k_f = 3.9 \times 10^{-5} \text{ s}^{-1}$$

$$k_b = 2.1 \times 10^{-3} \text{ L mol}^{-1} \text{ s}^{-1}$$

$$\therefore K_c = \frac{k_f}{k_b} = \frac{3.9 \times 10^{-5}}{2.1 \times 10^{-3}} \text{ mol L}^{-1}$$

$$= 0.0186 \text{ mol L}^{-1}$$

$$\therefore K'_c \text{ of the required reaction} = \frac{1}{K_c}$$

$$= 53.85 \text{ L mol}^{-1}$$

8. (b) : As $\frac{1}{T}$ increases (T decreases) $\log K$ or K decreases. Thus, given reaction is exothermic, i.e., $\Delta H^\circ < 0$.

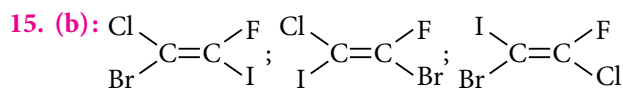
$$\log_e K = -\frac{\Delta H^\circ}{RT} + \frac{\Delta S^\circ}{R}$$

$$\text{Thus, slope is } -\frac{\Delta H^\circ}{R} \text{ and } \Delta A^\circ = \frac{\Delta S^\circ}{R}$$

9. (a) 10. (a) 11. (c) 12. (c)

13. (d) : Compound with N, S and carbon will form NaSCN to give red ppt.

14. (a)



(Each will have two geometrical isomers)

16. (c) : More solubility means more $[\text{OH}^-]$.

17. (c) : Cerussite is PbCO_3 , PbSO_4 is anglesite.

18. (b) 19. (a)

20. (b) : Valence shell electronic configuration is $4d^{10}5s^0$

21. (d)

22. (a) : $\Delta H = \Delta E + \Delta n_g RT$

For, $\text{C}_2\text{H}_4(\text{g}) + 3\text{O}_2(\text{g}) \longrightarrow 2\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$
 $\Delta E = -1415 \text{ kJ}$ $\Delta n_g = 2 - (3 + 1) = -2$
Mol. wt. of $\text{C}_2\text{H}_4 = 28\text{g}$

$$\Delta H = -1415 - 2 \times \frac{8.3}{1000} \times 300$$

$$= -1415 - 4.98 = -1419.98 \text{ kJ}$$

From 28 g heat release is $\approx 1420 \text{ kJ}$

From 1.4 g heat release is $= \frac{1420}{28} \times 1.4 \approx 71 \text{ kJ}$

23. (b): $\Delta G = -nFE = -2.303 RT \log K$

$$\log K = \frac{nFE}{2.303RT} = \frac{nE}{0.059} = \frac{2 \times 0.295}{0.059}$$

$$\log K = 10$$

$$K = 10^{10}$$

24. (c): $K_c = \frac{K_p}{(RT)^{\Delta n}} = \frac{0.41}{(0.082 \times 300)^{-1}}$

$$= 0.41 \times 0.082 \times 300$$

$$= 10.08 \text{ L mol}^{-1}$$

25. (c): First equation is obtained by adding the 2nd and 3rd equations. So,

$$K_1 = K_2 \cdot K$$

26. (c): $\text{pH} = 5 \Rightarrow [\text{H}^+] = 10^{-5} \text{ M}$

100 times dilution decreases the concentration of $[\text{H}^+]$ to 10^{-7} M .

New pH of acidic solution $= -\log 10^{-7}$
 $= 7$ (not possible)

Total $[\text{H}^+] = 10^{-7} + 10^{-7}$ (from water)
 $= 2 \times 10^{-7}$

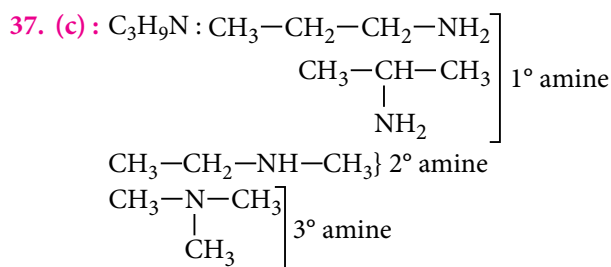
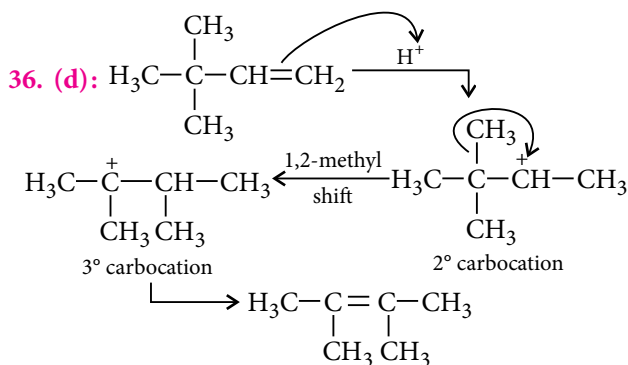
Actual new pH $= -\log (2 \times 10^{-7})$
 $= -\log 2 - \log 10^{-7}$
 $= -0.3 + 7 = 6.7$

27. (a): Calculate i , $\Delta T_f = iK_f m$

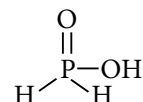
28. (a) 29. (c) 30. (c) 31. (b)

32. (b) 33. (a) 34. (b)

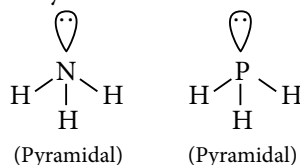
35. (c): $\text{Rate} \propto \frac{1}{\text{Stability of alkene}}$



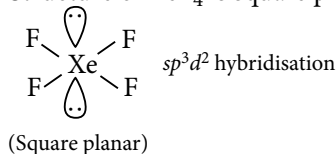
38. (c): All oxy-acids of phosphorus which contain P—H bond act as reductant. There are one —OH group and two P—H bonds in H_3PO_2 .



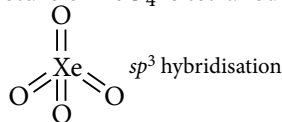
39. (a): (i) Hybridisation: sp^3 [σ -bonds = 3, $lp = 1$]
geometry: tetrahedral



(ii) Structure of XeF_4 is square planar.

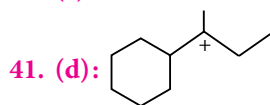


Structure of XeO_4 is tetrahedral



Graphite = sp^2 ; Diamond = sp^3
 $\text{SiCl}_4 = sp^3$; $\text{PCl}_5 = sp^3d$

40. (c)

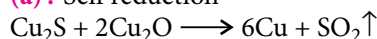


Intermediate 3° carbocation is formed which is more stable. Thus, no rearrangement in carbocation takes place.

So product is not possible.

42. (b): $\text{Ti}(22) = 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^2$
Order of energy is $3s < 3p < 4s < 3d$

43. (a): Self reduction



44. (b) 45. (b)



ADVANCED CHEMISTRY BLOC

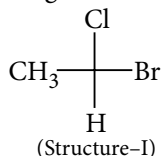
(FISCHER PROJECTION)

Mukul C. Ray, Odisha

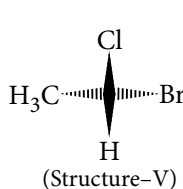
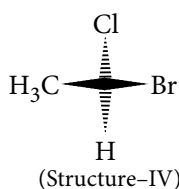
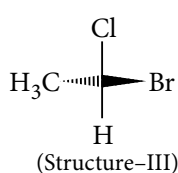
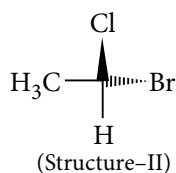
FISCHER PROJECTION AND FLYING WEDGE

It's easier to draw a circle on the paper than to draw a sphere because a circle is two-dimensional whereas a sphere is a three-dimensional entity. Similarly, it is tough to represent the three-dimensional properties of compounds in a running narrative. Nature has specified tetrahedral geometry for a saturated carbon center. This makes the subject matter of stereochemistry tricky. Good use of 3D imagination, understanding of involved logics, use of models, patience and interest, and moreover some tricks helped immensely to understand the yet another magnificent creation of nature, the tetrahedral carbon.

While writing the structure like the following, it is known that the bond angles are not 90° as is apparent.



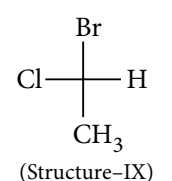
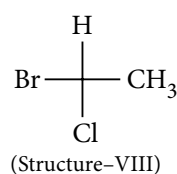
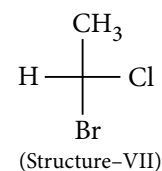
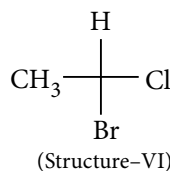
The central carbon is in sp^3 -hybridised state and the geometry is perfectly tetrahedral. It is never possible to keep all the bonds simultaneously on the plane of the paper. Then which bonds are on the plane of the paper, which bonds are projecting up and which are down?



Note that wedges (\blacktriangle) are the up stereo bonds; the dashes (\cdots) are down stereo bonds, and straight lines

are the bonds on the plane of the paper. These three-dimensional presentations of a tetrahedral carbon are acknowledged as Flying-Wedge model.

Again, are the following planar projections identical as structure-I?

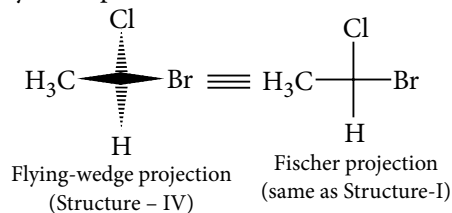


Flat or planar projections of tetrahedral carbon centers are recognised as Fischer projections. Fischer projection guidelines are:

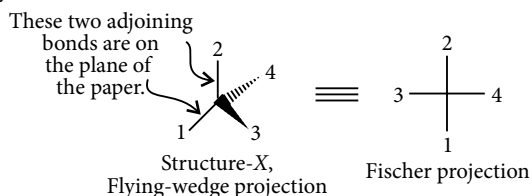
- The paper bisects the tetrahedral center in such a way that no bonds lie on it.
- The two up stereo bonds are on the horizontal line and the two down stereo bonds are on the vertical line.

The described set-up is preset. No other arrangements are acceptable. This means while writing a tetrahedral molecule on the flat paper, assume that the substituents placed on the horizontal line are projecting above and those on the vertical line are projecting down the paper; no substituent is on the plane of the paper.

Now, examine out of structures- II, III, IV and V, which is exactly a 3D presentation of structure-I.

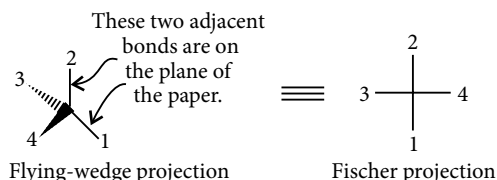


Imagine someone holding the flying-wedge model in such a way that three atoms including the central atom are on the plane of the paper. In that case, the relation between the 3D model of flying wedge and Fischer projection would be as follows :



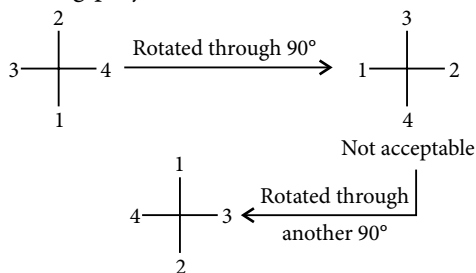
Note that structures-II and III are never written as so, rather they are written as structure-X or its mirror image form. However, Structures-IV and V are written in the same way as they are shown.

The same model when sited in the following opposite way, the relations are shown below :

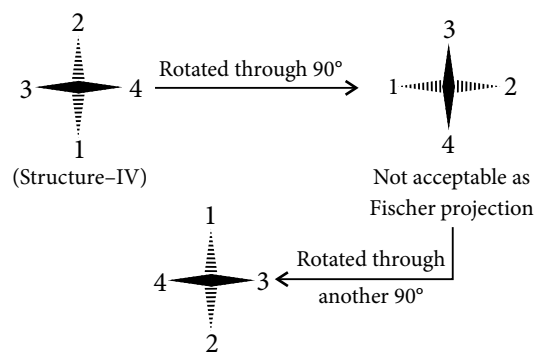


Note that the number 4 substituent is on the wedge in the flying-wedge model now, whereas in the previous case it was on the dash.

The same Fischer formula when rotated through 90° and then through another 90° i.e., 180° in total then the following projection formulae are obtained :

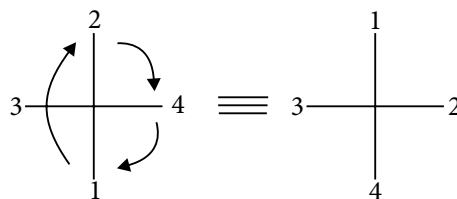


The 2nd projection formula in the above sequence is not acceptable as has been quoted. In the Fischer formula on the extreme left, the number 3 and number 4 atoms are on the horizontal line means they are projecting up above the paper. On rotation by 90° , the up stereo bonds will come to the vertical line, which is not acceptable. But by again rotating it through another 90° , the up stereo bonds come to the horizontal line and the planar formula now fits Fischer's restrictions. The following flying-wedge presentation of the above same sequence will give the clear understanding.



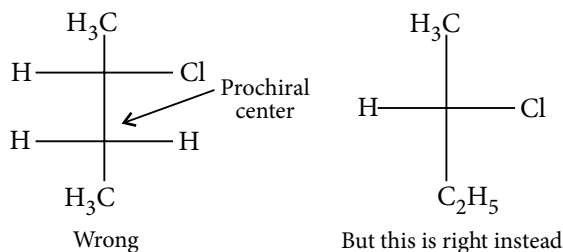
Now, it is clear that Fischer projection formulae cannot be rotated through 90° (and obviously 270°) on the plane of the paper, though 180° rotation is absolutely permissible. Structures-VII and IX cannot represent the same molecule as structure -I, but structure-VIII (obtained by 180° rotation) is quite identical with structure-I.

The another logically perfect way of representing the Fischer models is that keeping any one constant, rotate the other three again to bring two up stereo bonds to the horizontal line.



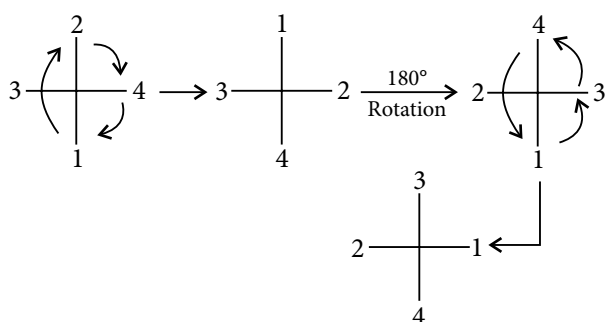
This means structure-VI is also identical as compared to structure-I. So, it is permissible to rotate any three as shown keeping the fourth fixed in Fischer formulae. Skipping the above logics of Fischer projection formulae, consider the following generalisations :

- Only chiral centres and not the prochiral or achiral centres are shown in Fischer projection formulae. This means that the number of points where horizontal lines intersect vertical lines in a Fischer projection formula is equal to the number of chiral carbons the molecule has.



- Fischer projection formula cannot be rotated through 90° (and obviously 270°) on the plane of the paper.
- It can however be rotated through 180° on the plane of the paper.
- Keeping one member constant you can rotate the other three relative to each other.

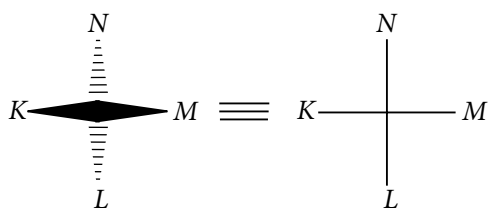
The above points apparently lead to one more generalisation. The following illustration with some permitted steps performed in consecutive manner leads to a new generalisation noted just below it.



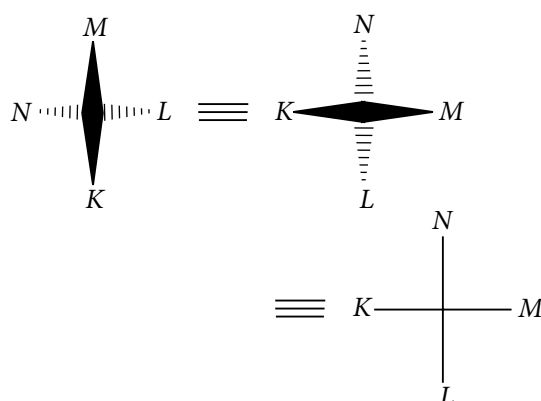
- Positions of each pair (substituents 2–3 form one pair and 1–4 form another pair) of vertical and horizontal substituents can be exchanged in Fischer projection formula.

Tips to handle Fischer and flying-wedge formulae.

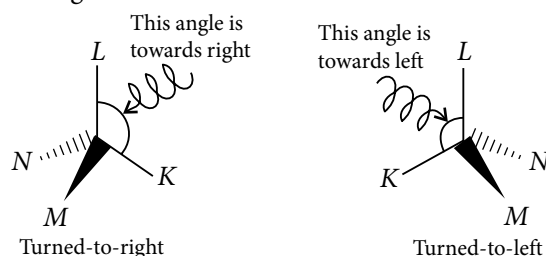
- If the flying-wedge presentation is such that the up stereo bonds (wedges) are on the horizontal line and the down stereo bonds (dashes) are on the vertical line, just copy the substituents as follows :



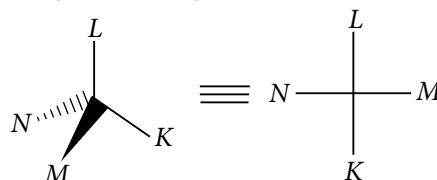
- If the Flying-wedge presentation is such that the up stereo bonds (wedges) are on the vertical line and the down stereo bonds (dashes) are on the horizontal line, rotate it just like rotating a steering wheel for flat 90° and then copy the substituents as follows :



- If the flying-wedge presentation is such that two bonds are on the plane of the paper and one projecting up while the other projecting down then designate them as turned-to-left and turned-to-right as follows :

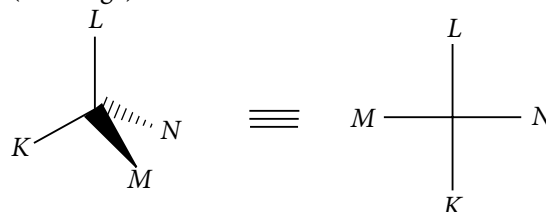


Say the flying-wedge model given is turned to right. Place the substituents that prepare the right turned angle on the vertical axis and bring the solid line (or wedge) to the right.



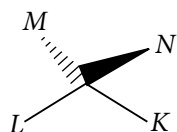
Remember it as “Turned-to-right, solid line (wedge) to the right”.

Say the flying-wedge model given is turned to left. Place the substituents that prepare the left turned angle on the vertical axis and bring the solid line (or wedge) to the left.

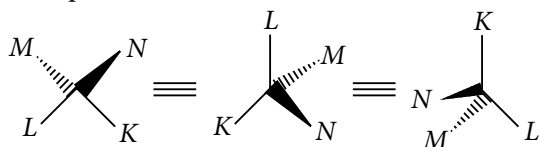


Remember it as “Turned-to-left, solid line (wedge) to the left”.

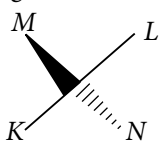
- If the flying-wedge model is given as follows :



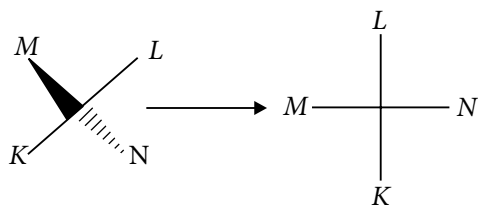
Rotate it either towards left or right to bring it to “turned-to-right” or “turned-to-left” pattern and then proceed as mentioned above.



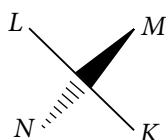
- If the flying-wedge model is as follows :



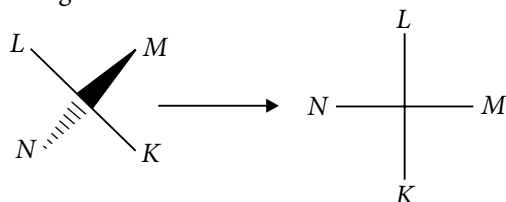
The simple diagonal carrying ‘L’ and ‘K’ is leaning towards left. Place them in a straight line and put ‘M’ to the left.



Remember it as “Diagonal to the left-solid line to the left”. If the situation is exactly opposite as :

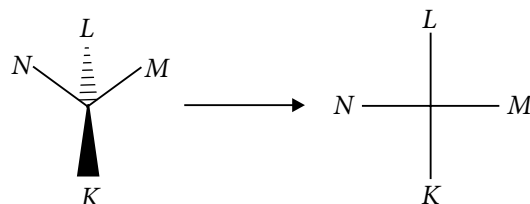
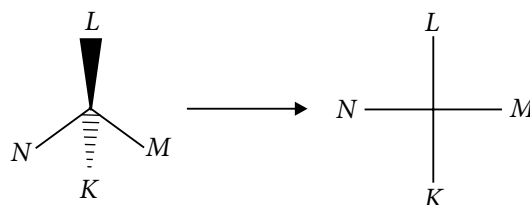


The diagonal carrying ‘L’ and ‘K’ is inclined towards right. Place them in a straight line and put ‘M’ in the right.

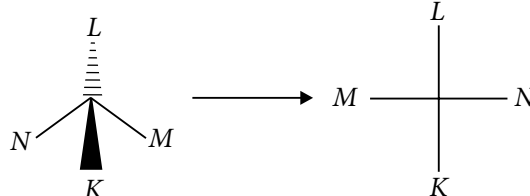
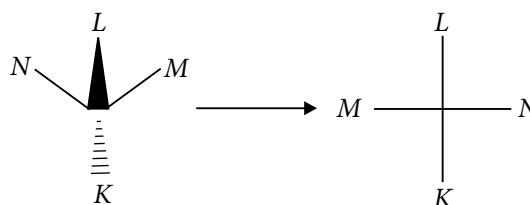


Remember it as “Diagonal to the right-solid line to the right”.

- If the flying-wedge projection is either of the following, just copy it.



Note it as “Wedge up angle down, copy it”.



Note it as “Wedge up angle up, copy its mirror image”.

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Do you have a question that you just can't get answered?

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The best questions and their solutions will be printed in this column each month.

Q1. What is the main difference between the processes of the preparation of the curd and the posset?

(Bishal Modak, West Bengal)

Ans. In setting of curd, milk changes into a new substance curd by the process called fermentation. During fermentation, bacteria use enzyme to produce energy from lactose due to which lactic acid is formed as a by-product. Lactic acid acts on casein (globular protein present in milk) and denatures these proteins. This denaturation destroys tertiary and quaternary structures of globular proteins and they are converted into fibrous proteins giving a thick texture to milk due to coagulation of proteins.

Posset preparation involves boiling up milk until it froths and then curdling it with citrus juice or alcohol (a jill of white wine).

Milk protein casein which is distributed inside the serum, has a tendency to get precipitated which is prevented due to colloidal calcium phosphate on the micelle surface. When citrus juice (mostly lemon juice) is added, it increases the milk acidity and due to lowering of pH calcium causes precipitation of the casein thus milk gets curdled. To further add to your knowledge, in possetting of a baby, (regurgitation of small quantities of undigested milk) enzyme chymosin also known as renin, is responsible to curdle or coagulate milk. Chymosin secretion is maximal during the first few days, after birth and declines thereafter.

Q2. Chirality is not the sufficient condition for optical activity. Explain.

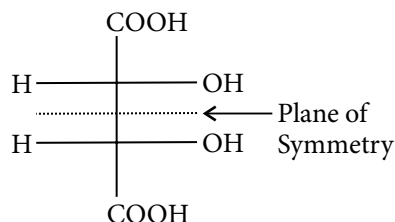
(Sagar Dahiya, Rohtak)

Ans. Chirality is the necessary but not the sufficient condition for optical activity. For a compound to show optical activity, it must have a non-superimposable mirror image.

This can be best explained with the help of a meso compound.

A meso compound is one whose half part is superimposable on its other half part even though it contains chiral centres.

Tartaric acid is the example of a meso compound which has two chiral centres but this compound is optically inactive because of presence of plane of symmetry.



When a plane polarised light is passed through this compound then half part of the molecule rotates the light in one direction and another half rotates the light with same magnitude but in opposite direction thus, no net rotation occurs. Hence, it does not show optical activity although it has two chiral centres.

Q3. Why does a finger stick to chilled ice tray?

(Chanchal Saini, Uttar Pradesh)

Ans. The ice tray in the freezer compartment of a refrigerator is usually at a temperature well below the freezing point of water. When the finger is in contact with metallic ice tray, it is quickly cooled below freezing point. The contact of finger might melt a bit of frost on the tray which quickly refreezes as the heat flows out to the cold tray. Also, there is always a little moisture on skin which would freeze upon contact, thereby bridging the finger and the cold tray.

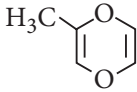
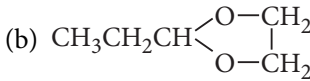
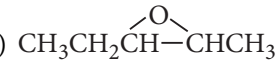


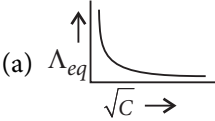
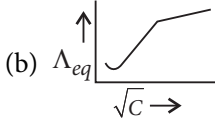
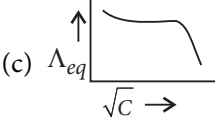
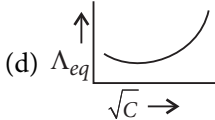
PRACTICE PAPER 2016 JEE MAIN

Exam Dates
OFFLINE : 3rd April
ONLINE : 9th & 10th April

- Assuming that the nucleus of F atom is a sphere of radius 5×10^{-13} cm, the density of matter in F nucleus is
(a) $6.02 \times 10^3 \text{ g cm}^{-3}$ (b) $5 \times 10^4 \text{ g cm}^{-3}$
(c) $6.02 \times 10^{13} \text{ g cm}^{-3}$ (d) $5 \times 10^{13} \text{ g cm}^{-3}$
- In the following reaction, the major product C is

$$\text{CH}_3\text{CH}_2\text{COOH} \xrightarrow{\text{SOCl}_2} \text{A} \xrightarrow{\text{LiAlH}(\text{O}i\text{-Bu})_3} \text{B} \xrightarrow{\text{HOCH}_2\text{CH}_2\text{OH}} \text{C}$$

(a)  (b) 
(c) $\text{CH}_3\text{CH}_2\text{CHO}$ (d) 
- If the temperature of a gas is raised from 27°C to 927°C , the root mean square speed of the gas
(a) gets halved (b) gets doubled
(c) remains same (d) gets $\sqrt{\frac{927}{27}}$ times.
- HCl cannot be used in place of H_2SO_4 in KMnO_4 titration, because
(a) HCl will reduce Mohr's salt or oxalic acid
(b) HCl will oxidise Mohr's salt or oxalic acid
(c) HCl will reduce KMnO_4
(d) none of these.
- The variation of equivalent conductance of a weak electrolyte with $(\text{concentration})^{1/2}$ is represented as

(a)  (b) 
(c)  (d) 
- The correct decreasing order of basicity is
(a) $\text{NH}_3 > \text{C}_2\text{H}_5\text{NH}_2 > (\text{C}_2\text{H}_5)_2\text{NH} > (\text{C}_2\text{H}_5)_3\text{N}$
(b) $(\text{C}_2\text{H}_5)_3\text{N} > (\text{C}_2\text{H}_5)_2\text{NH} > \text{C}_2\text{H}_5\text{NH}_2 > \text{NH}_3$
(c) $(\text{C}_2\text{H}_5)_2\text{NH} > \text{C}_2\text{H}_5\text{NH}_2 > (\text{C}_2\text{H}_5)_3\text{N} > \text{NH}_3$
(d) $(\text{C}_2\text{H}_5)_2\text{NH} > (\text{C}_2\text{H}_5)_3\text{N} > \text{C}_2\text{H}_5\text{NH}_2 > \text{NH}_3$
- Which of the following complexes are not correctly matched with the hybridisation of their central metal ion?
(i) $[\text{Ni}(\text{CO})_4] : sp^3$ (ii) $[\text{Ni}(\text{CN})_4]^{2-} : sp^3$
(iii) $[\text{CoF}_6]^{3-} : d^2sp^3$ (iv) $[\text{Fe}(\text{CN})_6]^{3-} : sp^3d^2$
Select the correct option.
(a) (i) and (ii) (b) (i) and (iii)
(c) (i), (iii) and (iv) (d) (ii), (iii) and (iv)
- The rate of reaction is equal to the rate constant, the order of reaction is
(a) 3 (b) 0
(c) 1 (d) 2
- A compound XY crystallised in bcc lattice with unit cell edge length of 480 pm, if the radius of Y^- is 225 pm, then the radius of X^+ is
(a) 190.70 pm (b) 225 pm
(c) 127.5 pm (d) none of these.
- Match List I with List II and select the correct answer using the codes given below the lists.

List I (Successive ionisation energies)			List II (Elements)	
	IE_1	IE_2	IE_3	
	(kJ mol^{-1})			
1.	2080	3963	6130	(P) H
2.	520	7297	11810	(Q) Li
3.	900	1758	14810	(R) Be
4.	800	2428	3600	(S) B
				(T) Ne

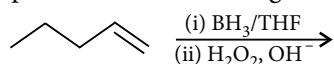
Codes :

- (a) 1 (R), 2 (Q), 3 (S), 4 (T)
(b) 1 (P), 2 (R), 3 (Q), 4 (S)
(c) 1 (R), 2 (P), 3 (Q), 4 (S)
(d) 1 (T), 2 (Q), 3 (R), 4 (S)

11. Each carbon in carbon suboxide is

- (a) sp^2 -hybridised
- (b) sp^3 -hybridised
- (c) sp -hybridised
- (d) sp^2 -hybridised but linked with one coordinate bond.

12. The product of the following reaction is



- (a) 1-pentanol
- (b) 2-pentanol
- (c) pentane
- (d) 1,2-pentanediol.

13. For all gases, $C_p - C_v = R$. This R is the

- (a) change in kinetic energy when temperature of 1 mole of a gas is increased by 1°C
- (b) mechanical work when temperature of 1 mole of a gas is increased by 1°C
- (c) change in potential energy when gas is allowed to fall
- (d) none of these.

14. A decimolar solution of potassium ferrocyanide is 50% dissociated at 300 K. The osmotic pressure of the solution [$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$] is

- (a) 2.4101 bar
- (b) 1.5420 bar
- (c) 7.4826 bar
- (d) 10.1281 bar

15. At the equilibrium position in the process of adsorption

- (a) $\Delta H > 0$
- (b) $\Delta H = T\Delta S$
- (c) $\Delta H > T\Delta S$
- (d) $\Delta H < T\Delta S$

16. Read the following statements :

- I. Al has greater affinity than that of Cr, for oxygen.
- II. Al can be used for reduction of Fe_2O_3 .
- III. Carbon is used for reduction of copper oxide (CuO).
- IV. SnO_2 can be reduced by carbon and CH_4 separately.

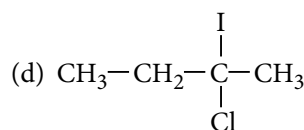
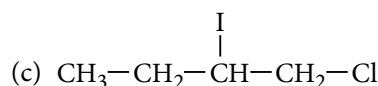
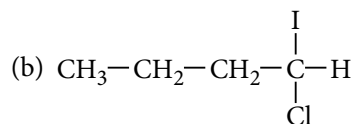
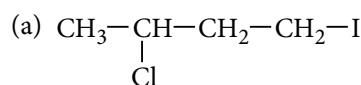
Choose the correct set of statements.

- (a) I, III
- (b) I, II
- (c) I, II, III
- (d) All of these.

17. If binding energy of electrons in a metal is 250 kJ mol^{-1} then, threshold frequency of the metal is

- (a) $3.8 \times 10^{38} \text{ s}^{-1}$
- (b) $3.8 \times 10^{35} \text{ s}^{-1}$
- (c) $6.3 \times 10^{11} \text{ s}^{-1}$
- (d) $6.3 \times 10^{14} \text{ s}^{-1}$

18. The product C obtained in the given reaction is



19. The total number of α and β -particles emitted in the nuclear reaction, ${}^{238}_{92}\text{U} \longrightarrow {}^{214}_{82}\text{Pb}$ is

- (a) 5
- (b) 6
- (c) 7
- (d) 8

20. White phosphorus on reaction with lime water gives calcium salt of an acid (A) along with a gas (X). Which of the following statements is correct?

- (a) (A) on heating gives (X) and O_2 .
- (b) The bond angle in (X) is less than that in case of ammonia.
- (c) (A) is a dibasic acid.
- (d) (X) is more basic than ammonia.

21. The following data were obtained when dinitrogen and dioxygen react together to form different compounds :

	Mass of dinitrogen	Mass of dioxygen
(i)	14 g	16 g
(ii)	14 g	32 g
(iii)	28 g	32 g
(iv)	28 g	80 g

Which law of chemical combinations is obeyed by the above experimental data?

- (a) Law of definite composition
- (b) Law of conservation of mass
- (c) Law of multiple proportions
- (d) Law of gaseous volumes

22. Match the List I and List II and pick the correct matching from the codes given below :

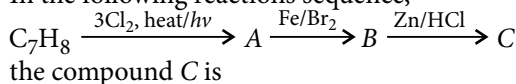
List I		List II	
(A)	Peroxyacetyl nitrate	1.	Waste incineration
(B)	Polycyclic aromatic hydrocarbons	2.	Global warming
(C)	Dioxins	3.	Photochemical smog
(D)	Indigo	4.	Carcinogens
(E)	IR active molecules	5.	Vat dye

- A B C D E
 (a) 3 4 1 5 2
 (b) 1 2 3 4 5
 (c) 3 5 1 2 4
 (d) 5 3 1 2 4

23. A copolymer of ethene and vinyl chloride contains alternate monomers of each type. What is the mass percentage of vinyl chloride in this copolymer?

- (a) 75% (b) 69%
 (c) 82% (d) 39%

24. In the following reactions sequence,



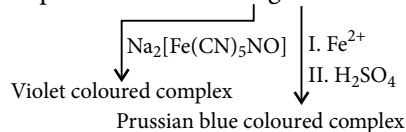
the compound C is

- (a) 3-bromo-2,4,6-trichlorotoluene
 (b) *o*-bromotoluene
 (c) *p*-bromotoluene
 (d) *m*-bromotoluene.

25. The oxidation states of A, B and C in a compound are +2, +5 and -2 respectively. The correct formula of the compound will be

- (a) A_2BC (b) $\text{A}_2(\text{BC}_4)_3$
 (c) $\text{A}_3(\text{BC}_4)_2$ (d) ABC

26. Organic compound 'A' \rightarrow Lassaigne's extract



The above Lassaigne's extract on treatment with Fe^{2+} does not give blood red colour because of the

- (a) absence of S in the organic compound
 (b) presence of halogen in the organic compound
 (c) dissociation of NaSCN into Na_2S and NaCN
 (d) conversion of NaSCN into HSCN .

27. In polysaccharides, the linkage connecting monosaccharides is called

- (a) glycosidic linkage (b) nucleoside linkage
 (c) glycogen linkage (d) peptide linkage.

28. The value of equilibrium constant for the reaction, $\text{HI}_{(g)} \rightleftharpoons \frac{1}{2}\text{H}_{2(g)} + \frac{1}{2}\text{I}_{2(g)}$ is 8.0. The equilibrium constant for the reaction, $\text{H}_{2(g)} + \text{I}_{2(g)} \rightleftharpoons 2\text{HI}$, will be

- (a) 16 (b) 1/8
 (c) 1/16 (d) 1/64

29. Which set has different class of compounds?

- (a) Tranquilizers : equanil, heroin, valium
 (b) Antiseptics : bithional, dettol, boric acid
 (c) Analgesics : naproxen, morphine, aspirin
 (d) Bactericidal : penicillin, aminoglycosides, ofloxacin

30. Which of the following statements is incorrect?

- (a) H_2O_2 is a pale blue viscous liquid.
 (b) H_2O_2 can act as an oxidising as well as a reducing agent.
 (c) In H_2O_2 , the two hydroxyl groups lie on the same plane.
 (d) H_2O_2 has an 'open-book' structure.

SOLUTIONS

1. (c) : Radius of F nucleus = 5×10^{-13} cm

$$\text{Volume of sphere} = \frac{4}{3}\pi r^3$$

Hence, volume of the nucleus of F atom

$$= \frac{4}{3} \times \frac{22}{7} \times (5 \times 10^{-13})^3 \text{ cm}^3$$

Also, mass of 6.023×10^{23} F atoms (or nuclei) = 19 g

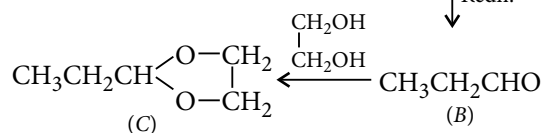
$$\Rightarrow \text{Mass of 1 nucleus} = \frac{19}{6.023 \times 10^{23}} \text{ g}$$

$$\text{Now, Density} = \frac{\text{Mass}}{\text{Volume}}$$

\therefore Density of matter in F nucleus

$$= \frac{19 \times 3 \times 7}{6.023 \times 10^{23} \times 4 \times 22 \times (5 \times 10^{-13})^3} \\ = 6.02 \times 10^{13} \text{ g cm}^{-3}$$

2. (b): $\text{CH}_3\text{CH}_2\text{COOH} \xrightarrow{\text{SOCl}_2} \text{CH}_3\text{CH}_2\text{C}(=\text{O})\text{Cl}$
 (A) \downarrow Redn.



3. (b): $u_{\text{rms}} = \sqrt{\frac{3RT}{M}}$

So, it is proportional to the temperature.

Now,

$$T_1 = 27^\circ\text{C} = 300 \text{ K}$$

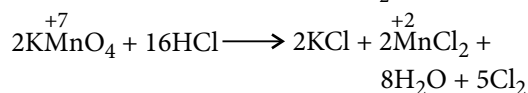
$$T_2 = 927^\circ\text{C} = 1200 \text{ K}$$

$$\frac{(u_{rms})_{\text{final}}}{(u_{rms})_{\text{initial}}} = \frac{\sqrt{\frac{3R(1200)}{M}}}{\sqrt{\frac{3R(300)}{M}}} = \sqrt{\frac{1200}{300}} = 2$$

\Rightarrow Ratio of final to initial *rms* speed is 2 : 1.

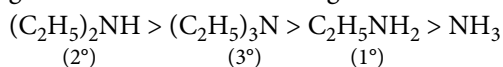
Hence, the root mean square speed of the gas gets doubled.

4. (c): If HCl is used, it is oxidised to Cl_2 .



5. (a): The equivalent conductance of weak electrolytes increases steeply with dilution especially in the low concentration region.

6. (d): In case of ethylamines, the combined effect of inductive effect, steric effect and solvation effect gives the order of basic strength as :



7. (d): $[\text{Ni}(\text{CN})_4]^{2-}$ is dsp^2 hybridised and not sp^3 ; $[\text{CoF}_6]^{3-}$ is sp^3d^2 hybridised and not d^2sp^3 . $[\text{Fe}(\text{CN})_6]^{3-}$ is d^2sp^3 hybridised and not sp^3d^2 .

8. (b): $r = k[A]^x \Rightarrow x = 0$ when $r = k$

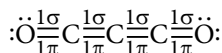
9. (a): Body diagonal is $2(r_+ + r_-) = \sqrt{3}a$

$$2(r_{X^+} + 225) = \sqrt{3} \times 480$$

$$r_{X^+} = \frac{831.36}{2} - 225 = 190.69 \approx 190.70 \text{ pm}$$

10. (d): 1. High value of IE_1 : (T) Ne (noble gas)
2. Large gap between IE_1 and IE_2 : (Q) Li($1s^2 2s^1$)
3. Large gap between IE_2 and IE_3 : (R) Be($1s^2 2s^2$)
4. $IE_3 > IE_2 > IE_1$: (S) B($1s^2 2s^2 2p^1$)

11. (c): The structure of carbon suboxide is



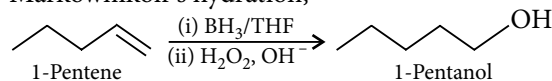
Number of hybrid orbitals of carbon

= no. of bonds + no. of lone pairs

$$= 2 + 0 = 2$$

Thus, each carbon is sp -hybridised.

12. (a): Hydroboration-oxidation leads to anti-Markownikoff's hydration,



13. (b): Mechanical work = $P\Delta V$

For one mole of a gas at temperature T ,

$$PV = RT$$

At constant pressure when temperature is increased by 1°C , volume increases (say by ΔV) then

$$P(V + \Delta V) = R(T + 1)$$

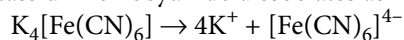
$$\therefore PV + P\Delta V = RT + R$$

$$\therefore P\Delta V = R$$

14. (c): For a decimolar solution of $\text{K}_4[\text{Fe}(\text{CN})_6]$ initial number of moles = 0.1

$$\text{Degree of dissociation } (\alpha) = \frac{50}{100} = 0.5$$

Potassium ferrocyanide dissociates as



Hence, $n = 5$

$$\alpha = \frac{i-1}{n-1} \text{ or } 0.5 = \frac{i-1}{5-1} \text{ or } i-1 = 2$$

$$\therefore i = 3$$

\therefore van't Hoff factor, $i = 3$

$$\pi V = i \times n \times R \times T \text{ or } \pi = i \times C \times R \times T$$

$$C = \frac{0.1}{10^{-3}} \text{ mol m}^{-3} = 100 \text{ mol m}^{-3}.$$

$$\text{or, } \pi = 3 \times 100 \times 8.314 \times 300 = 7.4826 \times 10^5 \text{ N m}^{-2} = 7.4826 \text{ bar}$$

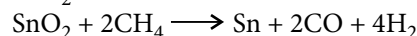
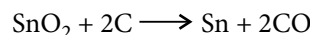
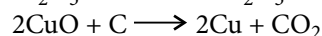
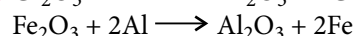
15. (b): At the equilibrium position in the process of adsorption

$$\Delta G = 0$$

$$\Delta H - T\Delta S = 0$$

$$\Delta H = T\Delta S$$

16. (d): $\text{Cr}_2\text{O}_3 + 2\text{Al} \longrightarrow \text{Al}_2\text{O}_3 + 2\text{Cr}$



17. (d): Binding energy = 250 kJ mol^{-1}

$$= \frac{250 \times 10^3}{6.023 \times 10^{23}} = 4.15 \times 10^{-19} \text{ J per electron}$$

Also, binding energy = $h\nu_0$

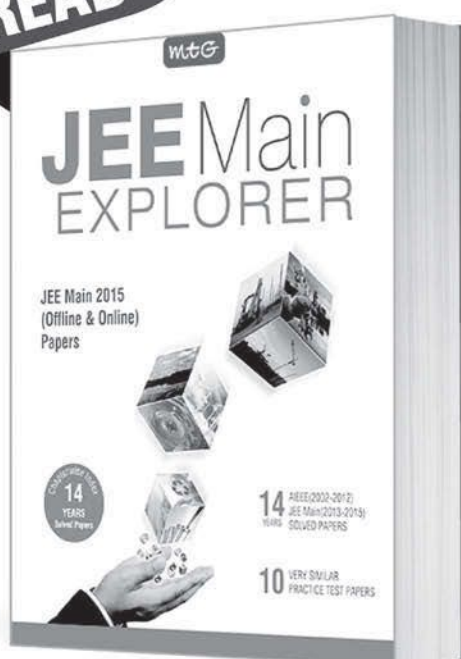
where ν_0 = threshold frequency

$$h\nu_0 = 4.15 \times 10^{-19}$$

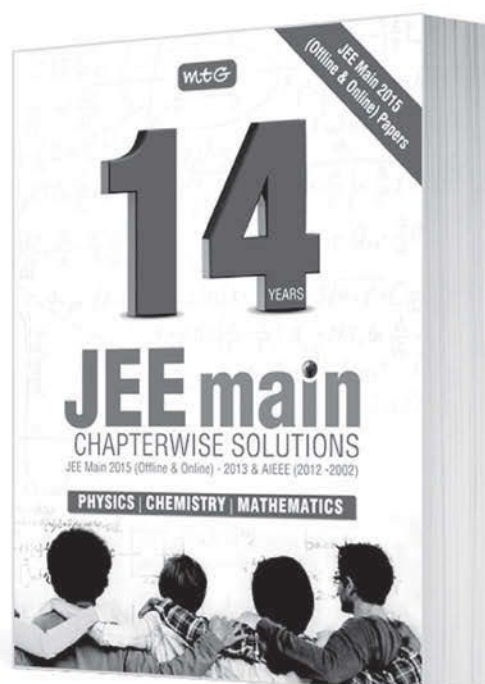
$$\nu_0 = \frac{4.15 \times 10^{-19}}{6.6 \times 10^{-34}} = 6.3 \times 10^{14} \text{ s}^{-1}$$

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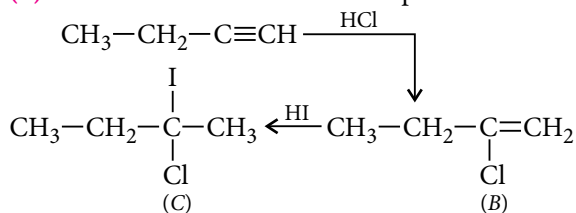
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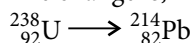
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18. (d): Markownikoff's addition takes place.



19. (d): The change is;



Decrease in mass = $(238 - 214) = 24$ amu

Mass of 1α -particle = 4 amu

$$\therefore \text{No. of } \alpha\text{-particles emitted} = \frac{24}{4} = 6$$

Number of β -particles emitted

$$= 2 \times \text{No. of } \alpha\text{-particles emitted} - (\text{At. no. of parent atom} - \text{At. no. of end product})$$

$$= 2 \times 6 - (92 - 82) = 2$$

Hence, number of α -particles emitted = 6

and number of β -particles emitted = 2

20. (b): $8\text{P} + 3\text{Ca}(\text{OH})_2 + 6\text{H}_2\text{O} \longrightarrow 3\text{Ca}(\text{H}_2\text{PO}_2)_2 + 2\text{PH}_3$ (X)

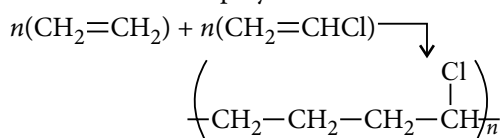
(A) is H_3PO_2 (hypophosphorous acid), a monobasic acid. PH_3 is less basic than NH_3 . The bond angle in (X) is less than that present in NH_3 .

H_3PO_2 on heating gives orthophosphoric acid and phosphine (X).

21. (c): Fixing the mass of dinitrogen as 28 g, masses of dioxygen combined will be 32, 64, 32 and 80 g in the given four oxides. These are in the ratio of 2 : 4 : 2 : 5 which is a simple whole number ratio. Hence, the given data obeys the law of multiple proportions.

22. (a): Peroxyacetyl nitrate (PAN) is the main component of photochemical smog, polycyclic aromatic hydrocarbons are found to be carcinogenic in nature, dioxins are disposed by incineration, indigo is a vat dye and IR active molecules result in global warming.

23. (b): The structure of copolymer is



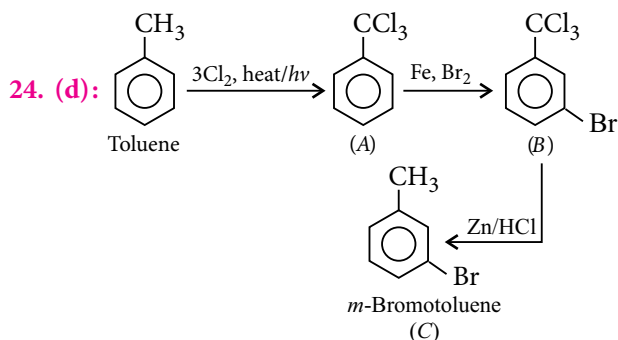
Molecular mass of ethene = 28

Molecular mass of vinyl chloride = 62.5

Empirical formula mass of copolymer = $28 + 62.5$
= 90.5

Mass percentage of vinyl chloride in the copolymer

$$= \frac{62.5 \times 100}{90.5} = 69.06\%$$

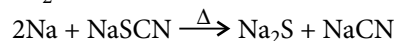


25. (c): The sum of oxidation numbers must be zero.

$$\therefore A_3(BC_4)_2$$

$$3(+2) + 2[1(+5) + 4(-2)] = 6 + 2(-3) = 0$$

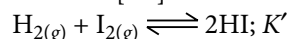
26. (c): Lassaigne's extract gives violet colour complex, it clearly confirms the presence of sulphur. The formation of Prussian blue coloured complex confirms the presence of nitrogen. If Lassaigne's extract does not give red colour complex it means excess of Na metal caused dissociation of NaSCN into Na_2S and NaCN.



27. (a): Covalent bond between two monosaccharides to form a disaccharide or polysaccharide is called glycosidic linkage.

28. (d): $\text{HI}_{(g)} \rightleftharpoons \frac{1}{2}\text{H}_{2(g)} + \frac{1}{2}\text{I}_{2(g)}; K$

$$K = \frac{[\text{H}_2]^{1/2}[\text{I}_2]^{1/2}}{[\text{HI}]} = 8$$



$$\Rightarrow K' = \frac{1}{K^2} = \frac{1}{64}$$

29. (a): Heroin is not a tranquilizer, it is a narcotic analgeic.

30. (c): H_2O_2 has non-planar structure. Two hydroxyl groups lie in different planes.



Exam on 1st May

AIPMT 2016

MODEL TEST PAPER

- Which of the following species is not paramagnetic in nature? [Atomic numbers; Be = 4, At. No., Ne = 10, As = 33, Cl = 17]
(a) Ne^{2+} (b) Be^+
(c) Cl^- (d) As^+
- The order of reactivity of different halogens towards halogenation of alkanes is
(a) $\text{F}_2 > \text{Cl}_2 > \text{Br}_2 > \text{I}_2$ (b) $\text{Br}_2 > \text{Cl}_2 > \text{F}_2 > \text{I}_2$
(c) $\text{I}_2 > \text{Br}_2 > \text{Cl}_2 > \text{F}_2$ (d) $\text{Cl}_2 > \text{F}_2 > \text{I}_2 > \text{Br}_2$
- Emission of an alpha particle leads to a/an
(a) decrease of 2 units in the charge of the atom
(b) increase of 2 units in the mass of the atom
(c) decrease of 2 units in the mass of the atom
(d) increase of 4 units in the mass of the atom.
- $\text{p}K_a$ value of acetic acid is 4.75. If the buffer solution contains 0.125 M acetic acid and 0.25 M sodium acetate, the pH of buffer solution is
(a) 5.05 (b) 5.5
(c) 4.9 (d) 5.75
- What is the heat of solution of sodium chloride if hydration energy of Na^+ is $-389.4 \text{ kJ mol}^{-1}$, hydration energy of Cl^- is $-382.3 \text{ kJ mol}^{-1}$ and lattice energy of $\text{NaCl} = +776 \text{ kJ mol}^{-1}$?
(a) $+8.6 \text{ kJ mol}^{-1}$ (b) $+4.3 \text{ kJ mol}^{-1}$
(c) -4.3 kJ mol^{-1} (d) -8.6 kJ mol^{-1}
- CoCl_2 gives blue colour with NH_4SCN in ethereal layer due to the formation of
(a) $(\text{NH}_4)_2[\text{Co}(\text{SCN})_4]$ (b) $(\text{NH}_4)_3[\text{Co}(\text{SCN})_6]$
(c) $(\text{NH}_4)[\text{Co}(\text{SCN})_4]$ (d) none of these.
- In a solid AB having rock-salt structure, B atoms occupy the corners of the cubic unit cell. If all the face centred atoms along one of the axis are removed, then the stoichiometry of the resultant structure will be
(a) A_2B_3 (b) A_2B
(c) A_4B_3 (d) A_3B_4
- Lucas reagent is
(a) conc. HCl and anhydrous ZnCl_2
(b) conc. HNO_3 and hydrous ZnCl_2
(c) conc. HCl and hydrous ZnCl_2
(d) conc. HNO_3 and anhydrous ZnCl_2 .
- Which of the given values is twice of the equivalent mass of the oxidising agent of the given reaction,
$$\text{SO}_2 + 2\text{H}_2\text{S} \longrightarrow 3\text{S} + 2\text{H}_2\text{O}$$

(a) 64 (b) 32
(c) 16 (d) 48
- When a vapour, at atmospheric pressure was gradually heated from 25°C its colour was found to deepen at first and then fade as the temperature was raised above 160° . At 600°C , the vapour was almost colourless, but its colour deepened when the pressure was raised at this temperature. The vapour was
(a) bromine
(b) a mixture of nitrogen dioxide and dinitrogen tetraoxide
(c) pure nitrogen dioxide
(d) pure dinitrogen tetraoxide.
- Which of the following statements does not form a part of Bohr's model of hydrogen atom?
(a) Energy of the electrons in the orbits are quantized.
(b) The electron in the orbit nearest to the nucleus has the lowest energy.
(c) Electrons revolve in different orbits around the nucleus.
(d) The position and velocity of the electrons in the orbit cannot be determined simultaneously.

12. For the preparation of *t*-butyl methyl ether by Williamson's method the correct choice of reagents is

(a) methoxide and *t*-butyl bromide
 (b) methanol and 2-bromo butane
 (c) 2-butanol and methyl bromide
 (d) *t*-butoxide and methyl bromide.

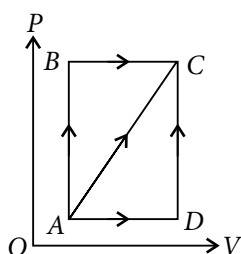
13. Correct order of bond length of the given species is

(a) $\text{CO}_3^{2-} > \text{CO}_2 > \text{CO}$ (b) $\text{CO}_2 > \text{CO} > \text{CO}_3^{2-}$
 (c) $\text{CO} > \text{CO}_2 > \text{CO}_3^{2-}$ (d) none of these.

14. A thermodynamic process is shown in the given figure. The pressures and volumes corresponding to some points in the figure are

$P_A = 3 \times 10^4 \text{ Pa}$, $P_B = 8 \times 10^4 \text{ Pa}$,
 $V_A = 2 \times 10^{-3} \text{ m}^3$, $V_D = 5 \times 10^{-3} \text{ m}^3$

In the process AB, 600 J of heat is added to the system and in BC, 200 J of heat is added to the system. The change in internal energy of the system in the process AC would be



(a) 560 J (b) 800 J
 (c) 600 J (d) 640 J

15. The oxidation of toluene with CrO_3 in the presence of $(\text{CH}_3\text{CO})_2\text{O}$ gives a product A, which on treatment with aqueous NaOH produces

(a) $\text{C}_6\text{H}_5\text{COONa}$ (b) 2, 4-diacetyltoleune
 (c) $\text{C}_6\text{H}_5\text{CHO}$ (d) $(\text{C}_6\text{H}_5\text{CO})_2\text{O}$

16. In acidic medium, KMnO_4 oxidises FeSO_4 solution. Which of the following statements is correct?

(a) 10 mL of 1 N KMnO_4 solution oxidises 10 mL of 5 N FeSO_4 solution.
 (b) 10 mL of 1 M KMnO_4 solution oxidises 10 mL of 5 M FeSO_4 solution.
 (c) 10 mL of 1 M KMnO_4 solution oxidises 10 mL of 1 M FeSO_4 solution.
 (d) 10 mL of 1 N KMnO_4 solution oxidises 10 mL of 0.1 M FeSO_4 solution.

17. Increasing order of acid strength among *p*-methoxyphenol, *p*-methylphenol and *p*-nitrophenol is

(a) *p*-methylphenol < *p*-methoxyphenol < *p*-nitrophenol
 (b) *p*-methoxyphenol < *p*-methylphenol < *p*-nitrophenol

(c) *p*-nitrophenol < *p*-methoxyphenol < *p*-methylphenol

(d) *p*-nitrophenol < *p*-methylphenol < *p*-methoxyphenol.

18. $\text{Fe}(\text{OH})_3$ can be separated from $\text{Al}(\text{OH})_3$ by the addition of

(a) NaCl solution (b) dil. HCl solution
 (c) NaOH solution (d) NH_4Cl and NH_4OH .

19. The order of reactivity of carbonyl compounds for nucleophilic addition is

(a) $\text{Ar}_2\text{C}=\text{O} > \text{R}_2\text{C}=\text{O} > \text{ArCHO} > \text{RCHO} > \text{H}_2\text{C}=\text{O}$
 (b) $\text{H}_2\text{C}=\text{O} > \text{R}_2\text{C}=\text{O} > \text{Ar}_2\text{C}=\text{O} > \text{RCHO} > \text{ArCHO}$
 (c) $\text{H}_2\text{C}=\text{O} > \text{RCHO} > \text{ArCHO} > \text{R}_2\text{C}=\text{O} > \text{Ar}_2\text{C}=\text{O}$
 (d) $\text{ArCHO} > \text{Ar}_2\text{C}=\text{O} > \text{RCHO} > \text{R}_2\text{C}=\text{O} > \text{H}_2\text{C}=\text{O}$

20. The correct order of increasing boiling points is

(a) 0.01 M NaNO_3 < 0.01 M $\text{La}(\text{NO}_3)_3$ < 0.01 M MgBr_2
 (b) 0.01 M NaNO_3 < 0.01 M MgBr_2 < 0.01 M $\text{La}(\text{NO}_3)_3$
 (c) 0.01 M MgBr_2 < 0.01 M $\text{La}(\text{NO}_3)_3$ < 0.01 M NaNO_3
 (d) 0.01 M $\text{La}(\text{NO}_3)_3$ < 0.01 M MgBr_2 < 0.01 M NaNO_3

21. When HCHO is treated with $\text{C}_6\text{H}_5\text{CHO}$ in presence of NaOH, the products are

(a) CH_3OH and HCOONa
 (b) $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$ and $\text{C}_6\text{H}_5\text{COONa}$
 (c) CH_3OH and $\text{C}_6\text{H}_5\text{COONa}$
 (d) HCOONa and $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$

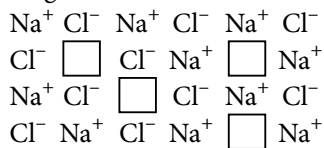
22. Which of the following is non-metallic?

(a) B (b) Be
 (c) Mg (d) Al

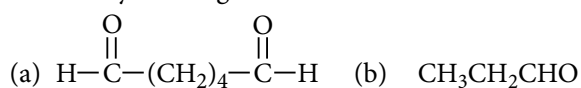
23. An ideal gas cannot be liquefied because

(a) its critical temperature is always above 0°C
 (b) its molecules are relatively smaller in size
 (c) it solidifies before becoming a liquid
 (d) forces operative between its molecules are negligible.

24. What type of crystal defect is indicated in the given diagram?



- (a) Frenkel defect
(b) Schottky defect
(c) Interstitial defect
(d) Frenkel and Schottky defects
25. Dry distillation of barium salt of hexane-1,6-dicarboxylic acid gives



26. Which of the following is posing threat to historical monument Taj?

- (a) Floods in Yamuna river
(b) Temperature mediated spoilage of marble
(c) Air pollutants from Mathura refinery
(d) Weathering of marble
27. Which of the following can possibly be used as an analgesic without causing addiction and modification?
- (a) Diazepam (b) Tetrahydrocannabinol
(c) Morphine
(d) *N*-Acetyl-*para*-aminophenol

28. A drop of a solution (volume = 0.05 mL) contains 6×10^{-7} mole of H^+ . If the rate of disappearance of H^+ is $6.0 \times 10^5 \text{ mol L}^{-1} \text{ s}^{-1}$, how long will it take for the H^+ in the drop to disappear?

- (a) $8.0 \times 10^{-8} \text{ s}$ (b) $2.0 \times 10^{-8} \text{ s}$
(c) $6.0 \times 10^{-6} \text{ s}$ (d) $2.0 \times 10^{-2} \text{ s}$

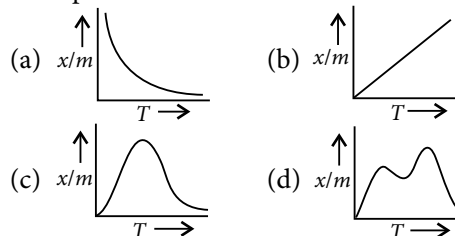
29. Amino acids usually exist in the form of Zwitter ions. This means that they consist of

- (a) the basic group $-\text{NH}_2$ and the acidic group $-\text{COOH}$
(b) the basic group $-\text{NH}_3^+$ and the acidic group $-\text{CO}_2^-$
(c) the basic group $-\text{CO}_2^-$ and the acidic group $-\text{NH}_3^+$
(d) no acidic or basic group.

30. On hydrolysis of starch, we finally get

- (a) glucose (b) fructose
(c) both (a) and (b) (d) sucrose.

31. Which of the following represents physical adsorption?



32. 2-Phenylethyl chloride undergoes alkaline hydrolysis to give 2-phenylethanol with

- (a) complete inversion of configuration
(b) racemization plus some inversion
(c) retention of configuration
(d) complete racemization.

33. Bakelite is prepared by the reaction between

- (a) phenol and formaldehyde
(b) tetramethylene glycol
(c) urea and formaldehyde
(d) ethylene glycol.

34. The emf of the three galvanic cells,

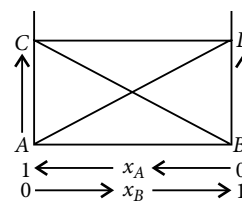
- $\text{Zn} | \text{Zn}^{2+} (1 \text{ M}) || \text{Cu}^{2+} (1 \text{ M}) | \text{Cu}$
- $\text{Zn} | \text{Zn}^{2+} (0.1 \text{ M}) || \text{Cu}^{2+} (1 \text{ M}) | \text{Cu}$
- $\text{Zn} | \text{Zn}^{2+} (1 \text{ M}) || \text{Cu}^{2+} (0.1 \text{ M}) | \text{Cu}$

are represented by E_1 , E_2 and E_3 , which of the following is true?

- (a) $E_1 > E_2 > E_3$ (b) $E_3 > E_2 > E_1$
(c) $E_3 > E_1 > E_2$ (d) $E_2 > E_1 > E_3$

35. Based on the given diagram,

which of the following statements regarding the solutions of two miscible volatile liquids is correct?

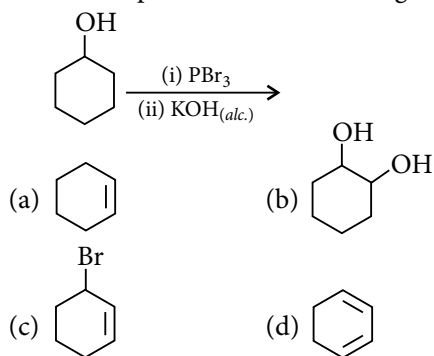


- Plots AD and BC show that Raoult's law is obeyed. For the solution of plot AD, B is a solvent and A is the solute and for the solution of plot BC, A is solvent and B is solute.
 - Plot CD shows that Dalton's law of partial pressures is obeyed by the binary solution of components A and B.
- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None of these

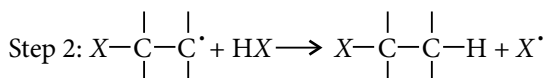
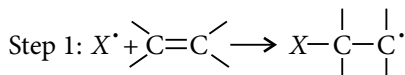
36. Na^+ , Mg^{2+} , Al^{3+} and Si^{4+} are isoelectronic, their ionic size will follow the order

- (a) $\text{Na}^+ > \text{Mg}^{2+} < \text{Al}^{3+} < \text{Si}^{4+}$
 (b) $\text{Na}^+ < \text{Mg}^{2+} < \text{Al}^{3+} < \text{Si}^{4+}$
 (c) $\text{Na}^+ > \text{Mg}^{2+} > \text{Al}^{3+} > \text{Si}^{4+}$
 (d) $\text{Na}^+ < \text{Mg}^{2+} > \text{Al}^{3+} < \text{Si}^{4+}$

37. Predict the product of the following reaction :



38. The propagation steps involved in the free radical addition of HX across a double bond are



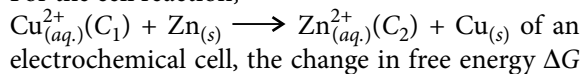
HI does not follow free radical addition because

- (a) step 1 is exothermic and step 2 is endothermic
 (b) step 1 is endothermic and step 2 is exothermic
 (c) both steps are exothermic
 (d) both steps are endothermic.
39. Given that, $\text{S} + 3/2\text{O}_2 \rightarrow \text{SO}_3 + 2x \text{ kcal}$ and $\text{SO}_2 + 1/2\text{O}_2 \rightarrow \text{SO}_3 + y \text{ kcal}$ then, the enthalpy of formation of SO_2 will be
- (a) $(2x + y) \text{ kcal mol}^{-1}$ (b) $(x - y) \text{ kcal mol}^{-1}$
 (c) $(x + y) \text{ kcal mol}^{-1}$ (d) $(y - 2x) \text{ kcal mol}^{-1}$
40. Which of the following elements is extracted commercially by the electrolysis of an aqueous solution of its compound?
- (a) Chlorine (b) Bromine
 (c) Sodium (d) Aluminium
41. 4 moles of HI are taken in a 1 litre closed vessel and heated till equilibrium is reached. At equilibrium, the concentration of H_2 is 1 mol L^{-1} . What is the equilibrium constant?
- (a) 4 (b) 0.5
 (c) 2 (d) 0.25

42. A coordination complex compound of cobalt has the molecular formula containing five ammonia molecules, one nitro group and two chlorine atoms for one cobalt atom. One mole of this compound produces three moles of ions in an aqueous solution. On reacting this solution with excess of AgNO_3 solution, two moles of AgCl are precipitated. The ionic formula for this complex would be

- (a) $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]\text{Cl}_2$
 (b) $[\text{Co}(\text{NH}_3)_5\text{Cl}](\text{Cl})(\text{NO}_2)$
 (c) $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)\text{Cl}](\text{NH}_3)(\text{Cl})$
 (d) $[\text{Co}(\text{NH}_3)_5](\text{NO}_2)\text{Cl}_2$

43. For the cell reaction,



- (a) $\ln(\text{C}_2)$ (b) $\ln(\text{C}_2/\text{C}_1)$
 (c) $\ln(\text{C}_1)$ (d) $\ln(\text{C}_1 + \text{C}_2)$

44. Deuteroammonia (ND_3) can be prepared

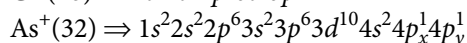
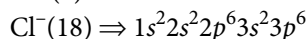
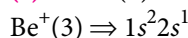
- (a) by fractionation of ordinary ammonia
 (b) by action of heavy water on magnesium nitride
 (c) by heating a solution of NH_4Cl in NaOD
 (d) none of the above.

45. Aniline is reacted with bromine water and the resulting product is treated with an aqueous solution of sodium nitrite in presence of dilute hydrochloric acid. The compound so formed is converted into a tetrafluoroborate which is subsequently heated dry. The final product is

- (a) *p*-bromoaniline
 (b) *p*-bromofluorobenzene
 (c) 1, 3, 5-tribromobenzene
 (d) 2, 4, 6-tribromofluorobenzene.

SOLUTIONS

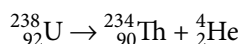
1. (c) : $\text{Ne}^{2+}(8) \Rightarrow 1s^2 2s^2 2p_x^2 2p_y^1 2p_z^1$



Cl^- is not paramagnetic as it has no unpaired electron.

2. (a) : In halogenation of alkanes, reactivity of halogens decreases with decrease in the electronegativity.

3. (a) : Emission of an α -particle (${}_2^4\text{He}$) leads to decrease of 2 units of charge and 4 units of mass.



4. (a): $\text{pH} = \text{p}K_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$

$$= 4.75 + \log \left(\frac{0.25}{0.125} \right) = 5.05$$

5. (b): $\Delta H_{\text{sol.}} = \text{Lattice energy} + \text{Hydration energy}$
Hydration energy of NaCl = $-389.4 - 382.3$
 $= -771.7 \text{ kJ mol}^{-1}$
 $\Delta H_{\text{sol.}} = 776 - 771.7 = 4.3 \text{ kJ/mol}$

6. (a)

7. (c): AB having rock-salt structure *i.e.*, the structure like Na^+Cl^- , in which four Na^+ and four Cl^- ions are present. So, in AB, four A^+ and four B^- ions will be present. In the unit cell of AB, when two face centred ions (*i.e.*, B^-) are removed. The contribution of two face-centred B^- ions = $2 \times \frac{1}{2} = 1$
Thus, the number of B^- ions left = $4 - 1 = 3$
Number of A^+ ions (unchanged) = 4
Thus, the resultant stoichiometry will be A_4B_3 .

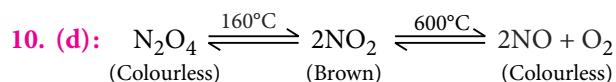
8. (a)

9. (b): In the equation; $\text{SO}_2 \xrightarrow{+4} \text{S}^0$
 SO_2 acts as an oxidising agent,

$$\text{Eq. mass of SO}_2 = \frac{\text{Molar mass}}{\text{Change in oxidation number}}$$

$$= \frac{64}{4} = 16$$

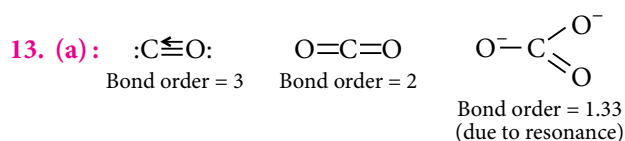
Twice of 16 = 32



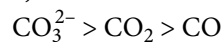
On heating the vapours, colour deepens due to conversion of colourless N_2O_4 to brown coloured NO_2 . But beyond 160°C , NO_2 gets converted to colourless mixture of NO and O_2 and the colour fades away. But if pressure is increased at 600°C then according to Le-Chatelier's principle, equilibrium will again shift towards brown coloured NO_2 due to lesser number of moles and colour again deepens. Thus, originally vapours contained pure N_2O_4 .

11. (d): It is uncertainty principle and not a Bohr's postulate.

12. (d): Tertiary halides do not undergo Williamson's synthesis. To get *t*-alkyl alkyl ether, *t*-alkoxide and primary alkyl halide should be used.



Bond length increases when bond order decreases hence, the correct order is



14. (a): No work is done along the path AB because this process is isochoric (for isochoric process, $\Delta V = 0$)

$$\therefore \text{Work done} = P\Delta V = 0.$$

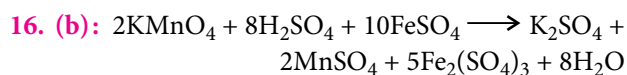
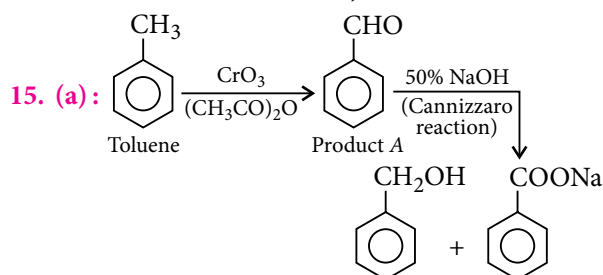
$$\begin{aligned} \text{Thus, the work done (w)} &= -P_B(V_D - V_A) \\ &= -8 \times 10^4 (5 \times 10^{-3} - 2 \times 10^{-3}) \\ &= -8 \times 10^4 \times 3 \times 10^{-3} \text{ J} = -240 \text{ J} \end{aligned}$$

The energy absorbed by the system

$$= (dq)_{AB} + (dq)_{BC} = 600 + 200 = 800 \text{ J}$$

The change in internal energy, $dE = dq + w$

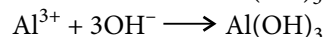
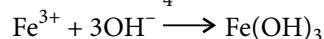
$$dE = 800 - 240 = 560 \text{ J}$$



One mole of KMnO_4 oxidises five moles of FeSO_4 *i.e.* 1 M KMnO_4 can oxidise equal amount of 5 M FeSO_4 .

17. (a)

18. (c): Fe^{3+} and Al^{3+} both belong to group III of inorganic analysis and both are precipitated as their hydroxides on adding group reagent, *i.e.*, NH_4OH in presence of NH_4Cl .

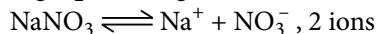
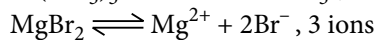
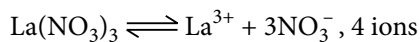


Only ppt. of $\text{Al}(\text{OH})_3$ is soluble in NaOH solution. Hence, $\text{Fe}(\text{OH})_3$ and $\text{Al}(\text{OH})_3$ are separated by using NaOH solution.

19. (c): With each substitution of hydrogen atom, reactivity of carbonyl compound decreases.

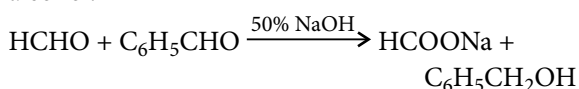
This is due to inductive effect in case of alkyl groups and resonance effect in case of aromatic groups.

20. (b): ΔT_b being a colligative property depends upon the number of solute particles *i.e.*, greater the number of ions larger will be the elevation in boiling point and thus, greater will be the boiling point.



\therefore The correct order of increasing boiling points is $0.01 \text{ M NaNO}_3 < 0.01 \text{ M MgBr}_2 < 0.01 \text{ M La}(\text{NO}_3)_3$

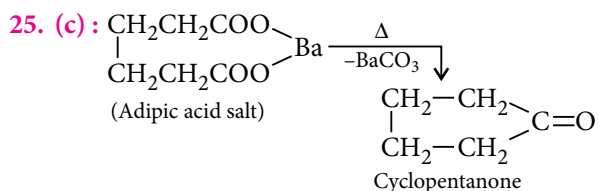
21. (d): The reaction is called crossed Cannizzaro's reaction and HCHO being the most reactive aldehyde is exclusively oxidised to sodium formate while the other aldehyde is always reduced to alcohol.



22. (a): B is a non-metal whereas Be, Mg and Al are metals.

23. (d): In an ideal gas, the intermolecular forces of attraction are negligible hence, it cannot be liquefied.

24. (b): As equal number of Na^+ and Cl^- ions are missing from their lattice sites, it is Schottky defect.



26. (c): Air pollutants from Mathura refinery are causing pitting and discolouring and making the Taj Mahal lustreless.

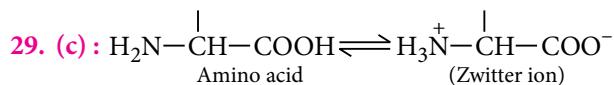
27. (d): *N*-Acetyl-*para*-aminophenol (or paracetamol) is an antipyretic which can also be used as an analgesic to relieve pain.

28. (b):
$$[\text{H}^+] = \frac{\text{No. of moles of } \text{H}^+}{\text{Volume}} = \frac{6 \times 10^{-7} \text{ mol}}{0.05 \times 10^{-3} \text{ L}} = 1.2 \times 10^{-2} \text{ M}$$

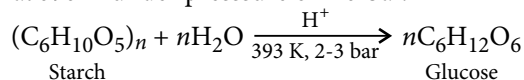
Now
$$r = \frac{-d[\text{H}^+]}{dt} = 6.0 \times 10^5 \text{ mol L}^{-1} \text{ s}^{-1}$$

$$\frac{1.2 \times 10^{-2} \text{ M}}{dt} = 6.0 \times 10^5 \text{ mol L}^{-1} \text{ s}^{-1}$$

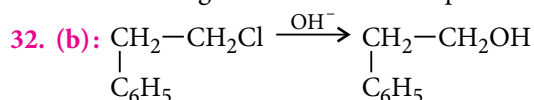
$$\therefore dt = \frac{1.2 \times 10^{-2} \text{ M}}{6.0 \times 10^5 \text{ M s}^{-1}} = 2 \times 10^{-8} \text{ s}$$



30. (a): Glucose is produced commercially by the hydrolysis of starch *i.e.*, by boiling it with dil. H_2SO_4 at 393 K under pressure of 2-3 bar.



31. (a): The physical adsorption isobar shows a decrease in x/m throughout with rise in temperature.



The reaction follows both, $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$ mechanisms.

33. (a): Phenol and formaldehyde undergo condensation polymerisation in the presence of either an acid or a base catalyst to give a cross-linked polymer called bakelite.

34. (d):
$$E_{\text{cell}} = E_{\text{cell}}^\circ - \frac{RT}{nF} \ln \frac{[\text{Zn}^{2+}]}{[\text{Cu}^{2+}]}$$

 In first case, $\frac{[\text{Zn}^{2+}]}{[\text{Cu}^{2+}]} = 1$

Thus, $E_1 = E_{\text{cell}}^\circ$

In second case, $\frac{[\text{Zn}^{2+}]}{[\text{Cu}^{2+}]} = \frac{0.1}{1} = 0.1$

$$\therefore E_2 = E_{\text{cell}}^\circ - \frac{0.0591}{n} \log 10^{-1} = E_{\text{cell}}^\circ + \frac{0.0591}{n}$$

In third case, $\frac{[\text{Zn}^{2+}]}{[\text{Cu}^{2+}]} = \frac{1}{0.1} = 10$

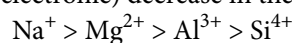
$$\therefore E_3 = E_{\text{cell}}^\circ - \frac{0.0591}{n} \log 10 = E_{\text{cell}}^\circ - \frac{0.0591}{n}$$

$$\therefore E_2 > E_1 > E_3$$

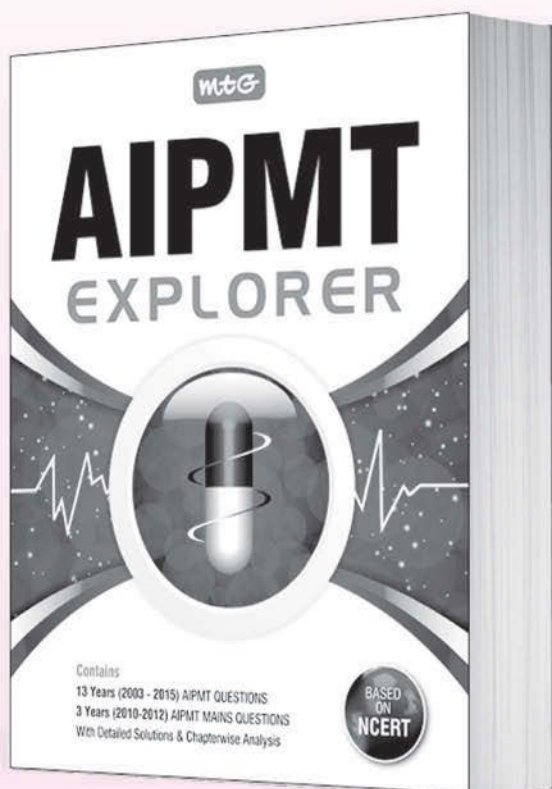
Thus, greater the value of $[\text{Zn}^{2+}]/[\text{Cu}^{2+}]$, lesser is the emf.

35. (c)

36. (c): In isoelectronic species as the charge on cations increases, their sizes decrease in the same order. Thus, the ionic sizes of the given cations, (isoelectronic) decrease in the order



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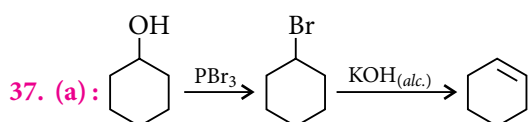
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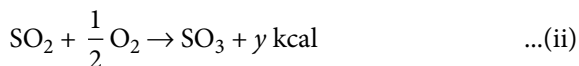
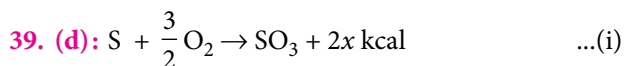
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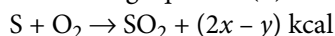
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38. (b)

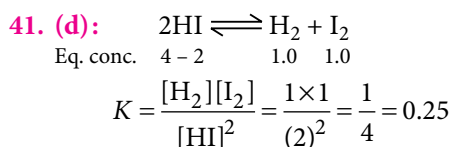


Subtracting equation (ii) from (i),



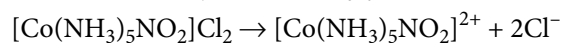
\therefore The enthalpy of formation of SO_2 is $-(2x - y)$
 $= y - 2x \text{ kcal mol}^{-1}$

40. (a): Chlorine is extracted commercially by electrolysis of an aqueous solution of NaCl.

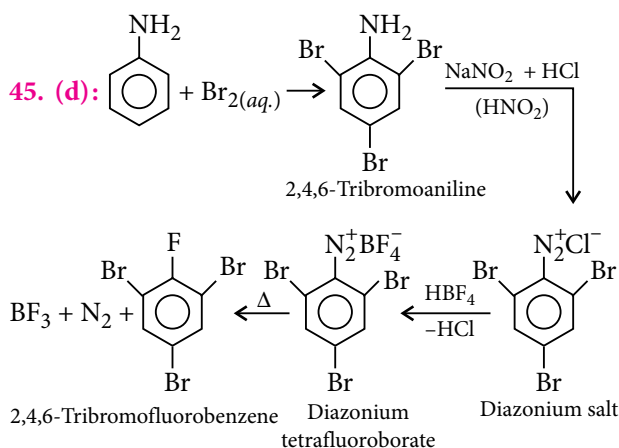
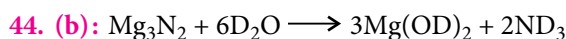


42. (a): As the complex gives two moles of AgCl ppt. with $AgNO_3$ solution, so the complex

must have two ionisable Cl atoms. Hence, the possible formula of the complex which gives three moles of ions may be $[Co(NH_3)_5NO_2]Cl_2$.



43. (b)



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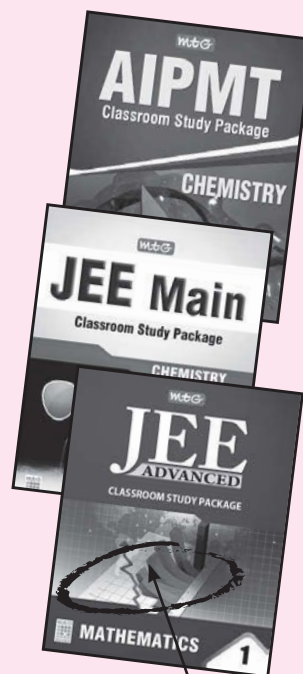
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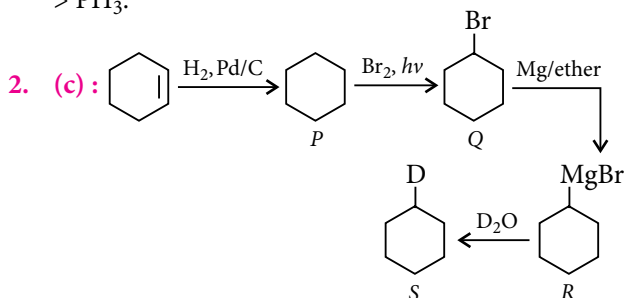


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CHEMISTRY MUSING

SOLUTION SET 32

1. (d): Electronegativities of N(3.0), P(2.1), As(2.0), Sb(1.9) and H(2.1) point out clearly that the correct order of decreasing polarity is $\text{NH}_3 > \text{SbH}_3 > \text{AsH}_3 > \text{PH}_3$.



3. (c): As the mole fraction of K_2CO_3 is 0.5 so, in the mixture equal moles of K_2CO_3 and KHCO_3 are present. Let the number of moles of each component in the mixture is a , then
- $$\frac{a \times 2 \times 1000}{\text{meq. of } \text{K}_2\text{CO}_3} + \frac{a \times 1 \times 1000}{\text{meq. of } \text{KHCO}_3} = 0.1 \times V$$
- $$3a = 10^{-4} \times V \quad \dots(i)$$

Now, as the total mass of the mixture is 1.252 g
 \therefore Mass of K_2CO_3 + Mass of KHCO_3 = 1.252 g
 $\Rightarrow a \times 138 + a \times 100 = 1.252$
 $a = 5.26 \times 10^{-3}$

Substituting the value of a in eq. (i)

$$3 \times 5.26 \times 10^{-3} = V \times 10^{-4}$$

$$V = 157.8 \text{ mL}$$

4. (d)
 5. (c): 3-Chlorocyclopropene is the least stable because of absence of resonance, while cyclopropenyl cation is the most stable due to its aromaticity (it contains π -electrons which fits the Huckel rule $4n + 2$ rule for $n = 0$). Allyl cation is stable only due to resonance.

6. (a): $\Delta S = 2.303 \times n \times C_p \times \log \frac{T_2}{T_1}$

Entropy change for heating water from 27°C to 100°C

$$\Delta S = 2.303 \times \frac{1000}{18} \times \frac{4180 \times 18}{1000} \log \frac{373}{300} = 910.55 \text{ J}$$

Entropy change for heating 1 kg H_2O to 1 kg steam at 100°C

$$\Delta S = \frac{\Delta H_v}{T} = \frac{23 \times 10^5}{373} = 6166.21 \text{ J}$$

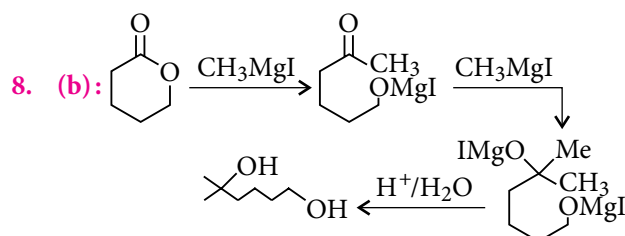
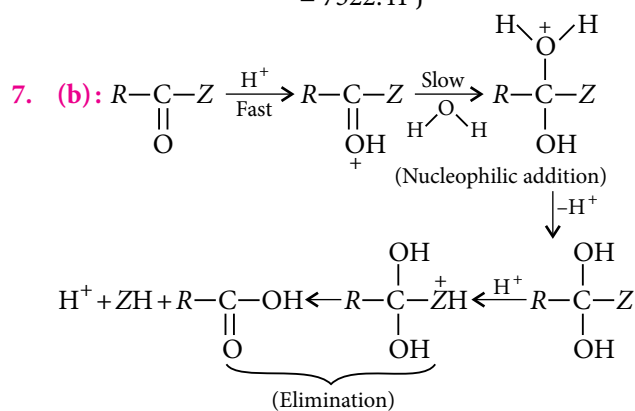
Entropy change for heating 1 kg steam from 373 to 473 K

$$\Delta S = \int_{373}^{473} \frac{n C_p \cdot dT}{T} = \int_{373}^{473} \frac{(1670 + 0.49T)}{T} dT$$

$$= 396.65 + 49 = 445.65 \text{ J}$$

$$\text{Total entropy change} = 910.55 + 6166.21 + 445.65$$

$$= 7522.41 \text{ J}$$



9. (2): Emission of α -particle from Rn is given by following nuclear reaction: ${}_{86}\text{Rn} \longrightarrow {}_{84}\text{X} + {}_2^4\text{He}$
 Because the sample is showing activity of ${}^{137}\text{Cs}$ thus its rate of decay is 3.7×10^{10} dps and
 rate = $\lambda \times$ Number of particles at $t = 0$ (i.e., N_0)
 $3.7 \times 10^{10} = 2 \times 10^{-6} \times N_0$
 $\Rightarrow N_0 = 1.85 \times 10^{16}$ atoms

Calculation of energy released in 1 hr :

E = Energy of one particle (5.5 MeV) \times No. of α -particles emitted in 1 hr.

$$\text{Using } t = \frac{2.303}{\lambda} \log \frac{N_0}{N}$$

$$60 \times 60 = \frac{2.303}{2 \times 10^{-6}} \log \frac{1.85 \times 10^{16}}{N}$$

$$\Rightarrow N = 1.837 \times 10^{16} \text{ atoms}$$

\therefore No. of Rn-atoms decayed = No. of α -particles emitted

$$= N_0 - N = 1.85 \times 10^{16} - 1.837 \times 10^{16}$$

$$= 1.3 \times 10^{14} \alpha\text{-particles}$$

And thus energy released

$$= 1.3 \times 10^{14} \times 5.5 \times 10^6 \times 1.6 \times 10^{-19}$$

$$= 114.4 \text{ J} \approx 72 \times 2 \Rightarrow x = 2$$

10. (8): $[\text{Ti}(\text{H}_2\text{O})_6]^{2+}$ is a d^2 system. In an octahedral system there are three t_{2g} lower energy levels with energy $-0.4\Delta_o$. Hence, as only two of these energy level, of t_{2g} are occupied so,
 $\text{CFSE} = 2(-0.4\Delta_o) = -0.8\Delta_o$
 Hence, $n \times 10^{-1}\Delta_o = 8 \times 10^{-1}\Delta_o$
 Thus, $n = 8$

CONCEPT MAP

SOME BASIC CONCEPTS OF CHEMISTRY

Some basic concepts of chemistry provide the base to elucidate the various observations on the physical and chemical properties of matter and the various laws of chemical combinations help in understanding the formation of compounds.

Classification

- **Matter**: Anything that has mass and occupies space.
- Based on physical state it is classified as solids, liquids and gases.
- Based on chemical composition it is classified as mixtures and pure substances.
- Mixtures are of two types *viz.* homogeneous (uniform composition) and heterogeneous (uneven composition).
- Pure substances are composed of elements (one type of particles) and compounds (more than one type of particles).

MATTER

Measurement

- SI system has seven base units for seven fundamental physical quantities and all other units are derived from these units.
- To change the order of magnitude, prefixes are added before the base units.
- **Significant figures**:
 - These are all certain digits with last digit uncertain.
 - All non-zero digits are significant.
 - Zeros preceding to first non-zero digit are not significant.
 - Zeros between two non-zero digits are significant.
 - Zeros on the right side of the decimal are significant.
- Some useful conversion factors:
 - Length – $1 \text{ \AA} = 10^{-8} \text{ cm} = 10^{-10} \text{ m}$, $1 \text{ nm} = 10^{-9} \text{ m}$, $1 \text{ pm} = 10^{-12} \text{ m}$
 - Volume – $1 \text{ L} = 1000 \text{ mL} = 1000 \text{ cm}^3 = 1 \text{ dm}^3 = 10^{-3} \text{ m}^3$
 - Pressure – $1 \text{ atm} = 760 \text{ mm or torr} = 101325 \text{ Pa}$,
 $1 \text{ bar} = 10^5 \text{ N m}^{-2} = 10^5 \text{ Pa}$
 - Energy – $1 \text{ calorie} = 4.184 \text{ J}$,
 $1 \text{ eV} = 1.6022 \times 10^{-19} \text{ J}$, $1 \text{ J} = 10^7 \text{ ergs}$

deci - 10^{-1}	deca - 10^1
centi - 10^{-2}	hecto - 10^2
milli - 10^{-3}	kilo - 10^3
micro - 10^{-6}	mega - 10^6
nano - 10^{-9}	giga - 10^9
pico - 10^{-12}	tera - 10^{12}

Laws of chemical combinations

- **Law of conservation of mass**: Matter can neither be created nor destroyed.
- **Law of definite proportions**: A given compound always contains exactly the same proportion of elements by weight.
- **Law of multiple proportions**: If two elements can combine to form more than one compound, the masses of one element that combine with a fixed mass of the other element are in the ratio of small whole numbers.
- **Gay Lussac's law of gaseous volumes**: When gases combine or are produced in a chemical reaction they do so in a simple ratio by volume provided all gases are at same temperature and pressure.

Particulate nature of matter

- **Dalton's atomic theory**:
 - Matter consists of indivisible atoms.
 - All the atoms of a given element have identical properties including identical mass. Atoms of different elements differ in mass.
 - Compounds are formed when atoms of different elements combine in a fixed ratio.
 - Chemical reactions involve reorganisation of atoms. These are neither created nor destroyed in a chemical reaction.
- **Avogadro's law**: Equal volumes of gases at the same temperature and pressure contain equal number of molecules.

Mole concept

- **Mole**: Collection of 6.022×10^{23} (Avogadro's number) particles
- **For atomic substances**:
 $1 \text{ Mole} = \text{Gram atomic mass} = 1 \text{ Gram atom} = 6.022 \times 10^{23} \text{ atoms}$
- **For molecular substances**:
 $1 \text{ Mole} = \text{Gram molecular mass} = 1 \text{ Gram molecule} = 6.022 \times 10^{23} \text{ molecules}$
- **For gaseous substances**:
 $1 \text{ mole} = 22.4 \text{ L at STP}$

Masses

- **Atomic mass unit (amu or u)**: Mass exactly equal to $1/12^{\text{th}}$ of the mass of an atom of C-12 isotope.
- **Atomic mass of an element**: Average relative mass of its atoms as compared to an atom of C-12 taken as 12.
- **Average atomic mass** (for isotopes only)
$$= \frac{\sum X_i A_i}{\sum X_i} \quad \text{where } X_i = \% \text{ abundance}$$
$$A_i = \text{atomic mass}$$
- **Gram atomic mass**: Atomic mass of an element expressed in grams.
- **Molecular mass**: Sum of atomic masses of all the elements present in a molecule.

Percentage composition, empirical and molecular formulae

- **Percentage composition**: Mass % of an element
$$= \frac{\text{Mass of that element in the compound}}{\text{Molar mass of the compound}} \times 100$$
- **Empirical formula**: It is the simplest whole number ratio of the atoms of various elements present in one molecule of the compound.
- **Molecular formula**: It is the formula showing exact number of atoms of various elements present in one molecule of the compound.
$$\text{Molecular formula} = n \times \text{Empirical formula}$$

where, n is a simple whole number.

IMPORTANT TERMS AND FORMULAE

Methods of expressing concentration

- Mass per cent (%) = $\frac{w_{\text{solute}}}{w_{\text{solution}}} \times 100$
- Mole fraction (x_A) = $\frac{n_A}{n_A + n_B}$, $x_B = \frac{n_B}{n_A + n_B}$
- Molarity (M) = $\frac{w_2 \times 1000}{M_2 \times V(\text{in mL})}$
- Molality (m) = $\frac{w_2 \times 1000}{M_2 \times w_1(\text{in g})}$
- Normality (N) = $\frac{w_2 \times 1000}{\text{Eq. mass of solute} \times V(\text{in mL})}$

Limiting reagent

The reactant which gets consumed completely in a reaction and limits the amount of product formed is called limiting reagent.



PRACTICE PAPER

AIIMS

EXAM ON
29th
MAY

1. The number of moles of KMnO_4 that will be required to react completely with one mole of ferrous oxalate in acidic medium is

(a) $\frac{2}{5}$ (b) $\frac{3}{5}$ (c) $\frac{4}{5}$ (d) 1

2. Which of the following has maximum energy?

(a) $3s$ $3p$ $3d$

(a) $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\uparrow$ $\uparrow\uparrow$ $\uparrow\uparrow$ $\uparrow\uparrow$

(b) $3s$ $3p$ $3d$

(b) $\uparrow\downarrow$ $\uparrow\uparrow$ $\uparrow\uparrow$ $\uparrow\uparrow$ \uparrow \uparrow

(c) $3s$ $3p$ $3d$

(c) $\uparrow\downarrow$ $\uparrow\uparrow$ $\uparrow\uparrow$ $\uparrow\uparrow$ $\uparrow\uparrow$ $\uparrow\uparrow$

(d) $3s$ $3p$ $3d$

(d) $\uparrow\downarrow$ $\uparrow\uparrow$ $\uparrow\uparrow$ $\uparrow\uparrow$ \uparrow \uparrow

3. Which of the following has maximum lattice energy?

(a) Li_2O (b) Na_2O (c) MgO (d) BaO

4. The temperature at which a real gas obeys the ideal gas laws over a wide range of pressure is

(a) critical temperature
(b) Boyle temperature
(c) inversion temperature
(d) reduced temperature.

5. Nitrogen and oxygen are diatomic molecules but their congeners are P_4 and S_8 respectively. This is because

(a) phosphorus and sulphur are solids
(b) phosphorus and sulphur polymerise as soon as they are formed
(c) phosphorus and sulphur catenate
(d) none of these.

6. Aniline is insoluble in water and possesses a vapour pressure of 10-15 mm Hg at 373 K. It can be conveniently purified by

(a) sublimation
(b) steam distillation
(c) fractional distillation
(d) fractional crystallisation.

7. Carbon tetrachloride has no net dipole moment because of

(a) its planar structure
(b) its regular tetrahedral structure
(c) similar sizes of carbon and chlorine atoms
(d) similar electron affinities of carbon and chlorine.

8. Phenol is reacted with phthalic anhydride in presence of conc. H_2SO_4 and heated. When the hot reaction mixture is poured in NaOH solution, then product formed is

(a) alizarin (b) methyl orange
(c) fluorescein (d) phenolphthalein.

9. In the closest packing of spheres of uniform size, the ratio of radii of octahedral and tetrahedral holes is

(a) $\frac{0.732}{0.414}$ (b) $\frac{0.414}{0.155}$
(c) $\frac{0.732}{0.225}$ (d) $\frac{0.414}{0.225}$

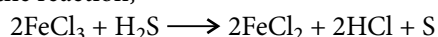
- 10.

Electrolyte	KCl	KNO_3	HCl	NaOAc	NaCl
Λ^∞ ($\text{S cm}^2 \text{ mol}^{-1}$)	149.9	145.0	426.2	91.0	126.5

Calculate $\Lambda^\infty_{\text{HOAc}}$ using appropriate molar conductances of the electrolytes listed above at infinite dilution in H_2O at 25°C .

(a) 517.2 (b) 552.7 (c) 390.7 (d) 217.5

11. In the reaction,



(a) FeCl_3 acts as an oxidising agent
(b) both H_2S and FeCl_3 are oxidised
(c) FeCl_3 is oxidised while H_2S is reduced
(d) H_2S acts as an oxidising agent.

12. Cryolite is
 (a) K_3AlF_6 and is used in the electrolysis of alumina for decreasing electrical conductivity
 (b) Na_3AlF_6 and is used in the electrolysis of alumina for lowering the melting point of alumina
 (c) Na_3AlF_6 and is used in the electrolytic purification of alumina
 (d) Na_3AlF_6 and is used in the concentration of alumina.
13. In the given sequence of reactions,

$$C_6H_6 \xrightarrow[H_2SO_4]{HNO_3} X \xrightarrow[FeCl_3]{Cl_2} Y$$
 Y can be
 (a) 3-nitrochlorobenzene
 (b) 1-nitrochlorobenzene
 (c) 4-nitrochlorobenzene
 (d) none of these.
14. The volume strength of 1.5 N H_2O_2 solution is
 (a) 3.0 (b) 8.4 (c) 4.8 (d) 8.0
15. Photochemical smog is formed in
 (a) summer during day time
 (b) summer during morning time
 (c) winter during morning time
 (d) winter during day time.
16. Correct configuration of the given compound is

$$\begin{array}{c} CH_3 \\ | \\ H - C - OH \\ | \\ CH_3 - C - OH \\ | \\ H \end{array}$$

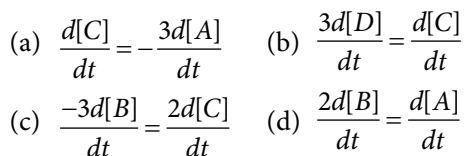
 (a) 1S, 2S (b) 1S, 2R (c) 1R, 2S (d) 1R, 2R.
17. 1-Propanol and 2-propanol can be best distinguished by
 (a) oxidation with alkaline $KMnO_4$ followed by reaction with Fehling solution
 (b) oxidation with acidic dichromate followed by reaction with Fehling solution
 (c) oxidation by heating with copper followed by reaction with Fehling solution
 (d) oxidation with concentrated H_2SO_4 followed by reaction with Fehling solution.
18. Addition of HCl to 2-methylbut-2-ene mainly gives
 (a) 1-chloro-2-methylbutane
 (b) 2-chloro-2-methylbutane
 (c) 2-chlorobutane
 (d) 1-chlorobutane.
19. The correct order of increasing $[H_3O^+]$ in the following aqueous solutions is
 (a) $0.01\text{ M } H_2S < 0.01\text{ M } H_2SO_4 < 0.01\text{ M } NaCl < 0.01\text{ M } NaNO_2$
 (b) $0.01\text{ M } NaCl < 0.01\text{ M } NaNO_2 < 0.01\text{ M } H_2S < 0.01\text{ M } H_2SO_4$
 (c) $0.01\text{ M } NaNO_2 < 0.01\text{ M } NaCl < 0.01\text{ M } H_2S < 0.01\text{ M } H_2SO_4$
 (d) $0.01\text{ M } H_2S < 0.01\text{ M } NaNO_2 < 0.01\text{ M } NaCl < 0.01\text{ M } H_2SO_4$
20. Which of the following is classified as a condensation polymer?
 (a) Dacron (b) Neoprene
 (c) Teflon (d) Acrylonitrile
21. Which of the following properties of a liquid increases with increase in temperature?
 (a) Density (b) Surface tension
 (c) Vapour pressure (d) Viscosity
22. Calculate the heat of formation of CO from the given reactions :

$$C + O_2 \rightarrow CO_2 ; \Delta H^\circ = -a\text{ kJ}$$

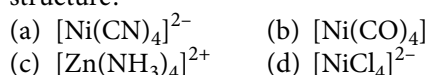
$$2CO + O_2 \rightarrow 2CO_2 ; \Delta H^\circ = -b\text{ kJ}$$

 (a) $b - 2a$ (b) $\frac{2a-b}{2}$
 (c) $\frac{b-2a}{2}$ (d) $2a - b$
23. How many electrons in an atom with atomic number 105 can have $(n + l) = 8$?
 (a) 30 (b) 17
 (c) 15 (d) Unpredictable
24. The electronegativity of the following elements increases in the order
 (a) C, N, Si, P (b) N, Si, C, P
 (c) Si, P, C, N (d) P, Si, N, C
25. Consider the following aqueous solutions and assume 100% ionization of electrolytes
 1. 0.1 m urea 2. $0.04\text{ m } Al_2(SO_4)_3$
 3. $0.05\text{ m } CaCl_2$ 4. $0.005\text{ m } NaCl$
 The correct statement regarding the above solutions is
 (a) freezing point will be lowest for solution 1
 (b) freezing point will be highest for solution 4
 (c) boiling point will be highest for solution 4
 (d) vapour pressure will be highest for solution 2
26. An organic compound 'A' reacts with sodium metal and forms 'B'. On heating with conc. H_2SO_4 , 'A' gives diethyl ether. 'A' and 'B' are respectively
 (a) C_2H_5OH and C_2H_5ONa
 (b) C_3H_7OH and C_3H_7ONa
 (c) CH_3OH and CH_3ONa
 (d) C_4H_9OH and C_4H_9ONa

27. In the reaction; $A + 2B \rightarrow 3C + D$, which of the following expressions does not describe change in the concentrations of various species as a function of time?



28. Which of the following complexes has square planar structure?



29. The general formula $(\text{RCO})_2\text{O}$ represents

- (a) an ester (b) a ketone
 (c) an ether (d) an acid anhydride.

30. Which among the following statements is false?

- (a) The adsorption may be monolayered or multilayered.
 (b) Particle size of adsorbent will not affect the amount of adsorption.
 (c) Increase of pressure increases the amount of adsorption.
 (d) Increase of temperature may decrease the amount of adsorption.

31. Compounds containing both amino and carboxylic acid groups are known as

- (a) diamines (b) carboxylic acids
 (c) amino acids (d) enzymes.

32. For the reaction, $3\text{O}_2 \rightarrow 2\text{O}_3$; $\Delta H = +ve$, the correct statement is

- (a) ozone is more stable than oxygen
 (b) ozone is less stable than oxygen and ozone decomposes to oxygen readily
 (c) oxygen is less stable than ozone and oxygen readily forms ozone
 (d) none of these.

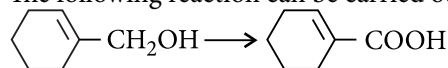
33. Thermal decomposition of higher hydrocarbons into lower hydrocarbons is called

- (a) aromatisation (b) cracking
 (c) reforming (d) isomerisation.

34. Which of the following is not stable according to molecular orbital theory?

- (a) He_2^+ (b) O_2^+ (c) C_2 (d) He_2

35. The following reaction can be carried out by



- (a) KMnO_4/H^+

- (b) CrO_3 in HCl /pyridine, Tollens' reagent

- (c) MnO_2 , Ag_2O

- (d) (b) or (c).

36. In a compound A_xB_y ,

- (a) number of moles of A = number of moles of B = number of moles of A_xB_y
 (b) eq. of A = eq. of B = eq. of A_xB_y
 (c) $y \times$ number of moles of A = $y \times$ number of moles of B = $(x + y) \times$ number of moles of A_xB_y
 (d) $y \times$ number of moles of A = $y \times$ number of moles of B

37. For the reaction, $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$, $K = 47.6$. If the initial number of moles of each reactant and product is 1 mole then at equilibrium

- (a) $[\text{I}_2] = [\text{H}_2]$, $[\text{I}_2] > [\text{HI}]$
 (b) $[\text{I}_2] < [\text{H}_2]$, $[\text{I}_2] = [\text{HI}]$
 (c) $[\text{I}_2] = [\text{H}_2]$, $[\text{I}_2] < [\text{HI}]$
 (d) $[\text{I}_2] > [\text{H}_2]$, $[\text{I}_2] = [\text{HI}]$

38. In XeF_2 , XeF_4 and XeF_6 , the number of lone pairs on Xe is respectively

- (a) 2, 3, 1 (b) 1, 2, 3
 (c) 4, 1, 2 (d) 3, 2, 1

39. The Cannizzaro reaction is not given by

- (a) trimethylacetaldehyde
 (b) acetaldehyde
 (c) benzaldehyde
 (d) formaldehyde.

40. Acetophenone is prepared from

- (a) Rosenmund reaction
 (b) Sandmeyer reaction
 (c) Wurtz reaction
 (d) Friedel Crafts reaction.

ASSERTION AND REASON

Directions : In the following questions (41-60), a statement of assertion is followed by a statement of reason. Mark the correct choice as :

- (a) If both assertion and reason are true and reason is the correct explanation of assertion.
 (b) If both assertion and reason are true but reason is not the correct explanation of assertion.
 (c) If assertion is true but reason is false.
 (d) If both assertion and reason are false.

41. **Assertion :** Cyclopentadienyl anion is much more stable than allyl anion.

Reason : Cyclopentadienyl anion is aromatic in character.

- 42. Assertion :** $\text{La}(\text{OH})_3$ is more basic than $\text{Lu}(\text{OH})_3$.
Reason : Size of Ln^{3+} decreases and shows more covalent character.
- 43. Assertion :** Reduction of but-2-yne with H_2 in presence of Lindlar's catalyst gives *cis*-2-butene.
Reason : Both alkyne and H_2 get adsorbed over the surface of the catalyst and the two H-atoms are then transferred to the triple bond from the same face.
- 44. Assertion :** F atom has a less negative electron affinity than Cl atom.
Reason : Additional electrons are repelled more effectively by $3p$ electrons in Cl atom than by $2p$ electrons in F atom.
- 45. Assertion :** A non volatile solute is mixed in a solution then elevation in boiling point and depression in freezing point both are equal.
Reason : Elevation in boiling point and depression in freezing point both depend on melting point of non-volatile solute.
- 46. Assertion :** Insulators have conductivity of the order of 10^4 to $10^7 \text{ ohm}^{-1} \text{ m}^{-1}$.
Reason : Insulators have free electrons.
- 47. Assertion :** 2, 4, 6-trinitrophenol is more acidic than 4-nitrophenol.
Reason : Phenol is a weaker acid than carbonic acid.
- 48. Assertion :** Oxalate ion is a bidentate ligand.
Reason : Oxalate ion has two donor atoms.
- 49. Assertion :** A reaction is spontaneous if $E_{\text{cell}} = +\text{ve}$.
Reason : For $E_{\text{cell}} = +\text{ve}$, ΔG is always $-\text{ve}$.
- 50. Assertion :** Acetylene is acidic in nature.
Reason : Acetylene is sp hybridised.
- 51. Assertion :** α -Hydrogen atoms in aldehydes and ketones are acidic.
Reason : The anion left after the removal of α -hydrogen is stabilized by inductive effect.
- 52. Assertion :** According to transition state theory, for the formation of an activated complex, one of the vibrational degrees of freedom is converted into a translational degree of freedom.
Reason : Energy of the activated complex is higher than the energy of reactant molecules.
- 53. Assertion :** Levigation is used for the separation of oxide ores from impurities.
Reason : Ore particles are removed by washing in a current of water.
- 54. Assertion :** Nitric oxide is paramagnetic.
Reason : Nitric oxide has an odd number of electrons (11 valence electrons) and so it is paramagnetic in the gaseous state.
- 55. Assertion :** ZSM-5 converts alcohols to gasoline.
Reason : Zeolites are porous catalysts.
- 56. Assertion :** Carboxylic acids exist as dimers.
Reason : Carboxylic acids show intramolecular hydrogen bonding.
- 57. Assertion :** Gases like N_2 , O_2 behave as ideal gases at high temperature and low pressure.
Reason : Molecular interaction is not the responsible factor.
- 58. Assertion :** Alkyl cyanide can be prepared by carbylamine reaction.
Reason : Ethylamine when heated with chloroform in presence of alcoholic KOH, cyanide is formed.
- 59. Assertion :** Alkali metals dissolve in liquid ammonia to give blue solution.
Reason : Alkali metals in liquid ammonia give solvated species of the type $[\text{M}(\text{NH}_3)_n]^+$ (M = alkali metals).
- 60. Assertion :** Both symmetrical and unsymmetrical ethers can be prepared by Williamson's synthesis.
Reason : Williamson's synthesis is an example of nucleophilic substitution reaction.

SOLUTIONS

- (b) :** The balanced redox reaction is :

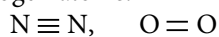
$$3\text{MnO}_4^- + 5\text{FeC}_2\text{O}_4 + 24\text{H}^+ \rightarrow 3\text{Mn}^{2+} + 5\text{Fe}^{3+} + 10\text{CO}_2 + 12\text{H}_2\text{O}$$

$$\therefore 5 \text{ moles of } \text{FeC}_2\text{O}_4 \text{ require } 3 \text{ moles of } \text{KMnO}_4$$

$$\therefore 1 \text{ mole of } \text{FeC}_2\text{O}_4 \text{ will require } \frac{3}{5} \text{ mole of } \text{KMnO}_4.$$
- (c) :** The order of increasing energy of the subatomic orbitals is $s < p < d < f$. The energy in excited state is more than that in the ground state. In option (c) two electrons are in excited states therefore, it has maximum energy.
- (c) :** MgO , Mg^{2+} ion is smallest in size and has double the charge in comparison to Li^+ and Na^+ ions.

4. (b)

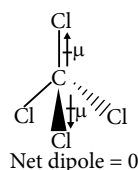
5. (c): As nitrogen and oxygen atoms are small and highly electronegative therefore, multiple bonds are formed between oxygen-oxygen and nitrogen-nitrogen atoms.



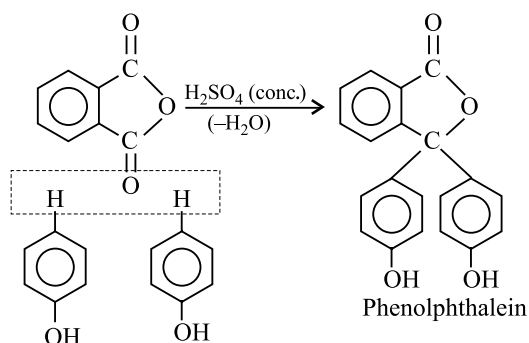
'S' and 'P' form stronger S — S and P — P bonds in comparison to O — O and N — N, thus, S exists as S_8 and P as P_4 .

6. (b)

7. (b): CCl_4 has a regular tetrahedral shape.



8. (d): Phenol couples with phthalic anhydride in presence of conc. H_2SO_4 to form phenolphthalein which is used as an indicator.



9. (d): Radius of tetrahedral void = $0.225 R$

Radius of octahedral void = $0.414 R$

where, R is the radius of the sphere in the close packed arrangement.

\therefore ratio of radii of octahedral and tetrahedral holes

$$= \frac{0.414R}{0.225R} = \frac{0.414}{0.225}$$

10. (c): $\Lambda_{\text{HOAc}}^{\infty} = \Lambda_{\text{NaOAc}}^{\infty} + \Lambda_{\text{HCl}}^{\infty} - \Lambda_{\text{NaCl}}^{\infty}$

$$= (91.0 + 426.2 - 126.5) \text{ S cm}^2 \text{ mol}^{-1}$$

$$= 390.7 \text{ S cm}^2 \text{ mol}^{-1}$$

11. (a)

12. (b): Cryolite (Na_3AlF_6) increases the electrical conductivity and lowers the melting point of alumina.

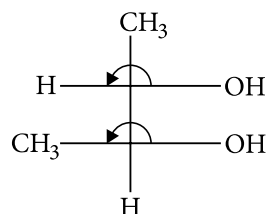
13. (a): Mixture of $\text{HNO}_3 + \text{H}_2\text{SO}_4$ generates NO_2^+ (nitronium ion) thus, nitration of benzene produces

nitrobenzene. As $-\text{NO}_2$ group is deactivating and *meta*-directing so, nitrobenzene on reaction with $\text{Cl}_2/\text{FeCl}_3$ produces 3-nitrochlorobenzene.

14. (b): Volume strength = Normality \times 5.6
 $= 1.5 \times 5.6 = 8.4$

15. (a): Photochemical smog is formed in summer during bright sunny day time.

16. (a):



Following the procedure outlined under 'Golden Rule' the absolute configuration is 1S, 2S.

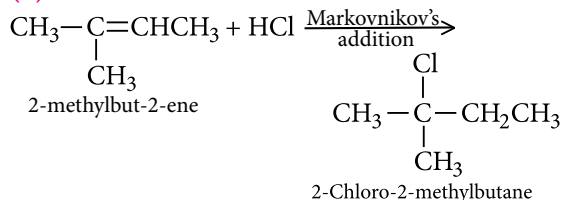
17. (c): $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \xrightarrow{\text{Cu}/\Delta} \text{CH}_3 - \text{CH}_2 - \text{CHO}$
 1-Propanol

$\xrightarrow{\text{Fehling solution}} \text{Cu}_2\text{O} \downarrow$

$\text{CH}_3 - \text{CH}(\text{OH}) - \text{CH}_3 \xrightarrow{\text{Cu}/\Delta} \text{CH}_3 - \text{C}(=\text{O}) - \text{CH}_3$
 2-propanol

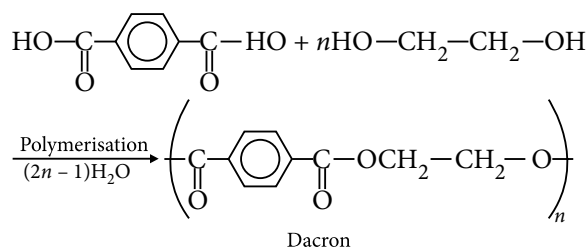
$\xrightarrow{\text{Fehling solution}} \text{No reaction}$

18. (b):

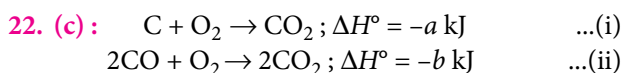


19. (c): H_2SO_4 is a strong acid having $\text{pH} < 7$. NaNO_2 on hydrolysis gives alkaline solution thus, $\text{pH} > 7$. NaCl is a neutral salt and H_2S is a weak acid.

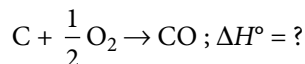
20. (a): Dacron is a condensation polymer of ethylene glycol and terephthalic acid. Formation of dacron can be shown as



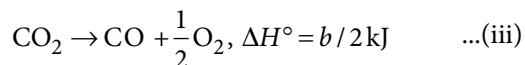
21. (c): Density, surface tension and viscosity of a liquid decrease with rise in temperature.



Formation of CO can be written as:

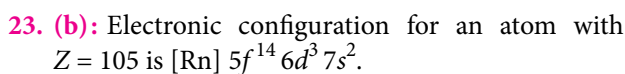


On dividing the equation (ii) by 2 and reversing it we get



On adding equations (i) and (iii), we get

$$\Delta H_f^\circ(CO) = \frac{b}{2} - a = \frac{b-2a}{2}$$



For 5f orbital:

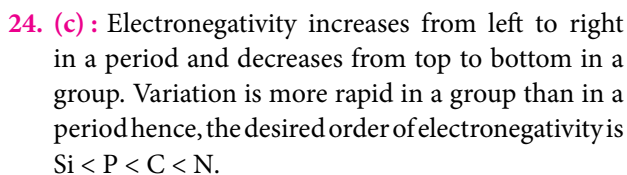
$$n + l = 5 + 3 = 8$$

For 6d orbital:

$$n + l = 6 + 2 = 8$$

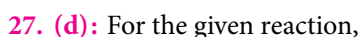
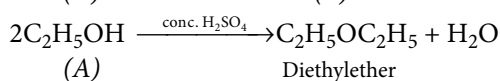
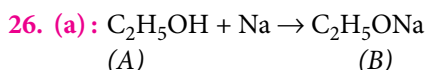
Electrons present in 5f = 14 and in 6d = 3.

Total no. of electrons = 17.

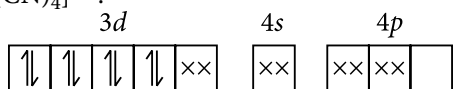
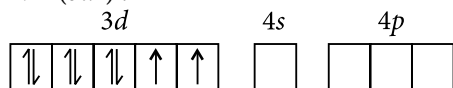


1. 0.1 m
2. $0.04 \times 5 = 0.2 \text{ m}$
3. $0.05 \times 3 = 0.15 \text{ m}$
4. $0.005 \times 2 = 0.01 \text{ m}$

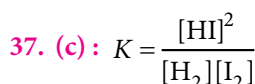
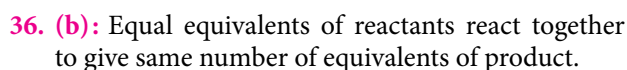
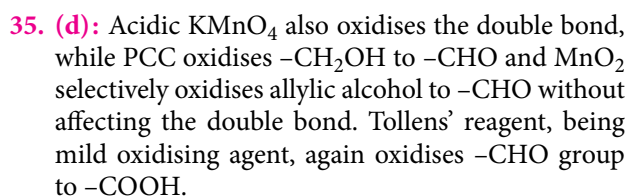
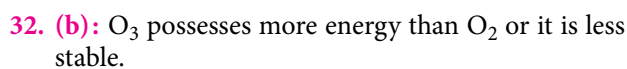
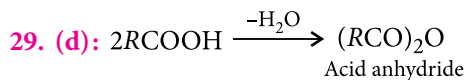
Solution 4 has lowest concentration. Depression in freezing point will be minimum and hence actual freezing point will be highest.



$$\frac{-d[A]}{dt} = \frac{-1}{2} \frac{d[B]}{dt} = +\frac{1}{3} \frac{d[C]}{dt} = +\frac{d[D]}{dt}$$



\therefore It has dsp^2 hybridisation and square planar structure.

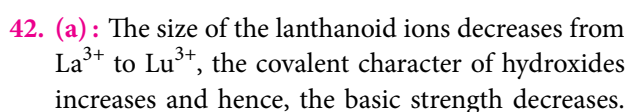
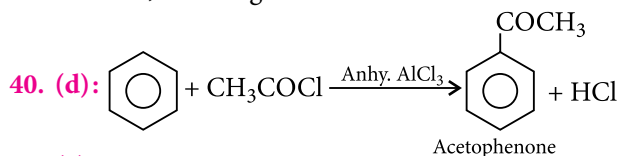
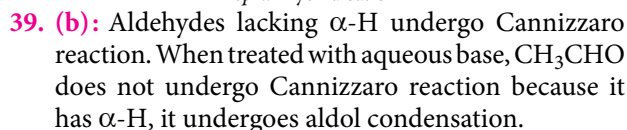
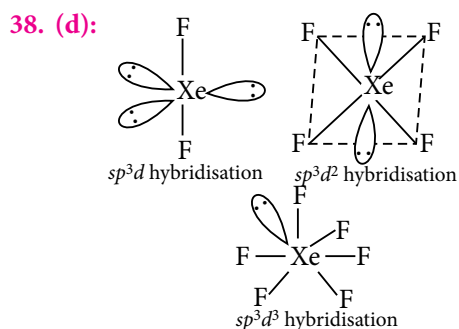


As 1 mole of H_2 reacts with 1 mole of I_2 , even after equilibrium, $[H_2] = [I_2]$.

$$\text{Hence, } K = \frac{[HI]^2}{[I_2]^2}$$

$$\text{or } \sqrt{K} = \frac{[HI]}{[I_2]} = \sqrt{47.6}$$

$$\text{i.e. } [HI] > [I_2] \text{ or } [I_2] < [HI]$$



Thus, $\text{La}(\text{OH})_3$ is most basic and $\text{Lu}(\text{OH})_3$ is least basic.

43. (a)

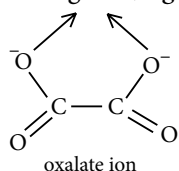
44. (c) : F atom has slightly lower affinity for the electrons than chlorine. It is due to the reason that additional electrons are repelled more effectively by $2p$ electrons in F than by $3p$ electrons in Cl atom.

45. (d) : Elevation in boiling point $(\Delta T_b) = K_b \times m$
Depression in freezing point $(\Delta T_f) = K_f \times m$
Elevation in boiling point and depression in freezing point are colligative properties *i.e.*, they depend only on the number of particles of the solute. Value of K_b and K_f are different, so ΔT_b and ΔT_f are also different.

46. (d) : Insulators have conductivity of the order of 10^{-20} to $10^{-10} \text{ ohm}^{-1} \text{ m}^{-1}$. In insulators, electrons are closely bound to individual atoms or ions *i.e.*, they do not have free electrons necessary for conduction of electrical current.

47. (b) : Electron withdrawing groups such as $-\text{NO}_2$, $-\text{CN}$, $-\text{X}$, increase the acidity. Greater the number of electron withdrawing groups more is the acidic character thus, 2, 4, 6-trinitrophenol is more acidic than 4-nitrophenol.

48. (a) : Ligands which can coordinate to the central metal atom or ion through two donor atoms are known as bidentate ligands, *e.g.*, oxalate ion.



49. (a) : For a redox reaction to be spontaneous, the EMF of the cell must be positive.

$$\text{As, } \Delta G = -nFE_{\text{cell}}$$

Therefore, for $E_{\text{cell}} = +\text{ve}$, ΔG is always negative.

50. (a) : The acidic nature of acetylene is described on the basis of higher electronegativity of sp hybridized carbon atom which pulls the $\text{C} - \text{H}$ bond pair more effectively to lose H^+ .

51. (c) : The anion left after the removal of α -hydrogen is stabilized by resonance effect.

52. (a) : $A + B \rightleftharpoons (AB)^{\ddagger} \longrightarrow \text{products}$.

The activated complex can be treated as a distinct chemical species in equilibrium with the reactants which then decomposes into products. It is, however,

a special molecule in which one vibrational degree of freedom has been converted to a translational degree of freedom along the reaction coordinate. The activated complex is unstable because it is situated at the maximum of the potential energy barrier separating the products from the reactants. The difference between the energy of the activated complex (E_1) and the energy of the reactants (E_2) is the activation energy E_a .

$$E_1 - E_2 = E_a, E_1 > E_2.$$

53. (c) : Oxide ores being heavier than the earthy or rocky gangue particles, settle down while lighter impurities are washed away.

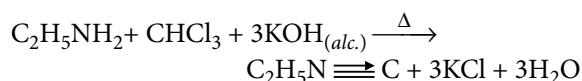
54. (a) : The Lewis structure of nitric oxide is represented as $:\text{N} \equiv \text{O}:$

55. (b)

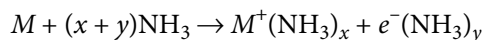
56. (c) : Carboxylic acids exist as dimers due to the formation of intermolecular hydrogen bonding.

57. (c) : N_2 , O_2 and other common gases behave as ideal gases at low pressure and high temperature. Under these conditions, molecular interactions are negligible and thus, gases obey Boyle's law, Charles' law and kinetic theory of gases.

58. (d) : When primary amines are heated with chloroform in the presence of alcoholic KOH, isocyanides are formed. This reaction is known as carbylamine reaction. *e.g.*, ethylamine gives ethyl isocyanide on treatment with CHCl_3 and alcoholic KOH.



59. (b) : Alkali metals dissolve in liquid ammonia to give blue solutions. These solutions contain ammoniated cations and ammoniated electrons.



When ordinary light falls on these ammoniated electrons, they get excited to higher levels by absorbing energy corresponding to red region of the visible light. Hence, transmitted light is blue and so, colour of the solution is blue.

60. (b) : Depending upon whether the alkyl halide and the alkoxide ion carry the same or different alkyl groups, both symmetrical and unsymmetrical ethers can be prepared by Williamson's synthesis.



PRACTICE PAPER BITSAT

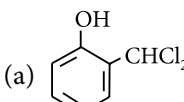
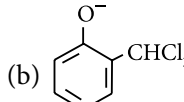
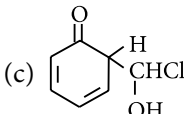
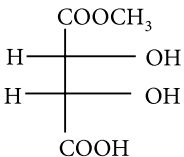
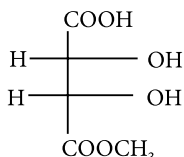
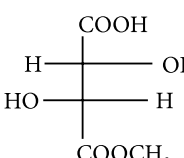
Exam date :
14th to 28th
May 2016

- The correct order of acidic strength is
(a) $\text{Cl}_2\text{O}_7 > \text{SO}_2 > \text{P}_4\text{O}_{10}$ (b) $\text{CO}_2 > \text{N}_2\text{O}_5 > \text{SO}_3$
(c) $\text{Na}_2\text{O} > \text{MgO} > \text{Al}_2\text{O}_3$ (d) $\text{K}_2\text{O} > \text{CaO} > \text{MgO}$
 - The standard enthalpies of formation at 25°C for $\text{CO}_{2(g)}$, $\text{H}_2\text{O}_{(l)}$ and $\text{CH}_3\text{OH}_{(l)}$ are $-393.5 \text{ kJ mol}^{-1}$, $-285.8 \text{ kJ mol}^{-1}$, $-238.7 \text{ kJ mol}^{-1}$ respectively. ΔH° for the combustion of 454 grams of methanol $\text{CH}_3\text{OH}_{(l)}$ is
(a) -440.2 kJ (b) -726.4 kJ
(c) $-6.26 \times 10^3 \text{ kJ}$ (d) $-10.3 \times 10^3 \text{ kJ}$
 - Electrode potential data are given below :
 $\text{Fe}_{(aq)}^{3+} + e^- \longrightarrow \text{Fe}_{(aq)}^{2+}; E^\circ = +0.77 \text{ V}$
 $\text{Al}_{(aq)}^{3+} + 3e^- \longrightarrow \text{Al}_{(s)}; E^\circ = -1.66 \text{ V}$
 $\text{Br}_{2(aq)} + 2e^- \longrightarrow 2\text{Br}_{(aq)}^-; E^\circ = +1.08 \text{ V}$
Based on the data, the reducing power of Fe^{2+} , Al and Br^- will increase in the order
(a) $\text{Br}^- < \text{Fe}^{2+} < \text{Al}$ (b) $\text{Fe}^{2+} < \text{Al} < \text{Br}^-$
(c) $\text{Al} < \text{Br}^- < \text{Fe}^{2+}$ (d) $\text{Al} < \text{Fe}^{2+} < \text{Br}^-$
 - The planar complex Mabcd gives
(a) two optical isomers
(b) two geometrical isomers
(c) three optical isomers
(d) three geometrical isomers.
 - 
(A)
- Half-life is independent of concentration of A. After 10 minutes volume of N_2 gas is 10 L and after complete reaction 50 L. Hence, rate constant is
(a) $\frac{2.303}{10} \log 5 \text{ min}^{-1}$ (b) $\frac{2.303}{10} \log 1.25 \text{ min}^{-1}$
(c) $\frac{2.303}{10} \log 2 \text{ min}^{-1}$ (d) $\frac{2.303}{10} \log 4 \text{ min}^{-1}$
- Three separate samples of a solution of a single salt gave these results. One formed a white precipitate with excess ammonia solution, one formed a white precipitate with NaCl solution and one formed a black precipitate with H_2S . The salt would be
(a) AgNO_3 (b) $\text{Pb}(\text{NO}_3)_2$
(c) $\text{Hg}(\text{NO}_3)_2$ (d) MnSO_4
 - An ester (A) with molecular formula, $\text{C}_9\text{H}_{10}\text{O}_2$ was treated with excess of CH_3MgBr and the complex so formed was treated with H_2SO_4 to give an olefin (B). Ozonolysis of (B) gave a ketone with molecular formula $\text{C}_8\text{H}_8\text{O}$ which shows positive iodoform test. The structure of (A) is
(a) $\text{C}_6\text{H}_5\text{COOC}_2\text{H}_5$ (b) $\text{C}_6\text{H}_5\text{COOC}_6\text{H}_5$
(c) $\text{CH}_3\text{OCH}_2\text{COC}_6\text{H}_5$
(d) $p\text{-CH}_3\text{OCOC}_6\text{H}_4\text{COCH}_3$
 - A crystal lattice with alternate positive and negative ions has radius ratio 0.524. Its coordination number is
(a) 4 (b) 3 (c) 6 (d) 12
 - Consider the following statements :
1. Atomic hydrogen is obtained by passing hydrogen through an electric arc.
2. Hydrogen gas will not reduce heated aluminium oxide.
3. Finely divided palladium absorbs large volume of hydrogen gas.
4. Pure nascent hydrogen is best obtained by reacting Na with $\text{C}_2\text{H}_5\text{OH}$.
Which of the given statements is/are correct?
(a) 1 only (b) 2 only
(c) 1, 2 and 3 (d) 2, 3 and 4
 - The ease of liquefaction of noble gases decreases in the order
(a) $\text{He} > \text{Ne} > \text{Ar} > \text{Kr} > \text{Xe}$
(b) $\text{Xe} > \text{Kr} > \text{Ar} > \text{Ne} > \text{He}$
(c) $\text{Kr} > \text{Xe} > \text{He} > \text{Ar} > \text{Ne}$
(d) $\text{Ar} > \text{Kr} > \text{Xe} > \text{He} > \text{Ne}$

11. Two liquids A and B have vapour pressures in the ratio $p_A^\circ : p_B^\circ = 1 : 2$ at a certain temperature. Suppose that we have an ideal solutions of A and B in the mole fractions ratio $A : B = 1 : 2$, the mole fraction of A in the vapour in equilibrium with the solution at the given temperature is
(a) 0.25 (b) 0.2 (c) 0.5 (d) 0.33
12. Pheromones are
(a) human hormones (b) animal hormones
(c) insect messenger chemicals
(d) insecticides.
13. The quantum numbers $+1/2$ and $-1/2$ for the electron spin represent
(a) rotation of the electron in clockwise and anticlockwise direction respectively
(b) rotation of the electron in anticlockwise and clockwise direction respectively
(c) magnetic moment of the electron pointing up and down respectively
(d) two quantum mechanical spin states which have no classical analogue.
14. The coagulation of 100 mL of colloidal solution of gold is completely prevented by addition of 0.25 g of a substance X to it before adding 1 mL of 10% NaCl solution. The gold number of X is
(a) 0.25 (b) 25 (c) 250 (d) 2.5
15. Which of the following statements is true?
(a) ΔG may be lesser or greater or equal to ΔH .
(b) ΔG is always proportional to ΔH .
(c) ΔG is always greater than ΔH .
(d) ΔG is always less than ΔH .
16. The percentage of hydrogen in H_2O and hydrogen peroxide are respectively 11.2% and 5.94%. This illustrates
(a) law of multiple proportions
(b) conservation of mass
(c) law of definite proportions
(d) law of reciprocal proportions.
17. Which of the following alkenes is most reactive towards cationic polymerization?
(a) $CH_2=CHCH_3$ (b) $CH_2=CHCl$
(c) $CH_2=CHC_6H_5$ (d) $CH_2=CHCOOCH_3$
18. Arsenic drugs are mainly used in the treatment of
(a) jaundice (b) typhoid
(c) syphilis (d) cholera.
19. Elements X, Y and Z have atomic numbers 19, 37 and 55 respectively. Which of the following statements is true about them?
(a) Their ionization potential would increase with increasing atomic number.
(b) 'Y' would have an ionization potential between those of 'X' and 'Z'.
(c) 'Z' would have the highest ionization potential.
(d) 'Y' would have the highest ionization potential.
20. The number of sp^3-s , sp^2-s , sp^3-sp^2 and sp^2-sp^2 bonds present in 2-butene respectively, are
(a) 2, 1, 1, 4 (b) 6, 2, 2, 1
(c) 2, 3, 4, 6 (d) 2, 2, 6, 1
21. Identify 'Z' in the given reaction.

$$C_6H_5NH_2 \xrightarrow{(CH_3CO)_2O} X \xrightarrow{Br_2/CCl_4} Y \xrightarrow[H^+]{HOH} Z$$

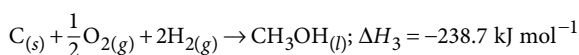
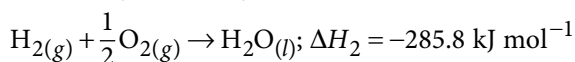
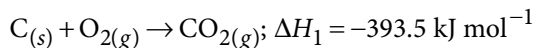
 (a) *p*-Bromoaniline (b) *p*-Bromoacetophenone
 (c) *p*-Bromoacetanilide (d) *o*-Bromoacetanilide
22. If all the following four compounds were sold at the same price, which would be cheapest for preparing an antifreeze solution for a car radiator?
(a) CH_3OH (b) C_2H_5OH
(c) $C_2H_4(OH)_2$ (d) $C_3H_5(OH)_3$
23. If M is the element of actinide series, the degree of complex formation decreases in the order
(a) $M^{4+} > M^{3+} > MO_2^{2+} > MO_2^+$
(b) $MO_2^+ > MO_2^{2+} > M^{3+} > M^{4+}$
(c) $M^{4+} > MO_2^{2+} > M^{3+} > MO_2^+$
(d) $MO_2^{2+} > MO_2^+ > M^{4+} > M^{3+}$
24. The open-chain glucose, (an aldohexose) and fructose (a 2-oxohexose) have and chiral carbons respectively
(a) 4, 4 (b) 4, 3 (c) 3, 3 (d) 3, 4
25. N_2 and O_2 are converted into monocations, N_2^+ and O_2^+ respectively. Which of the following is wrong?
(a) In N_2^+ , N – N bond weakens.
(b) In O_2^+ , the O – O bond order increases.
(c) In O_2^+ , paramagnetism decreases.
(d) N_2^+ becomes diamagnetic.
26. All the following substances react with water. The pair that gives the same gaseous product is
(a) K and KO_2 (b) Na and Na_2O_2
(c) Ca and CaH_2 (d) Ba and BaO_2
27. Gabriel phthalimide synthesis can be used for the preparation of amine from
(a) CH_3CH_2Br (b) $(CH_3)_3CBr$
(c) $p-CH_3OC_6H_4Br$ (d) $p-CH_3C_6H_4Br$
28. Secondary structure of protein refers to
(a) mainly denatured proteins and structure of prosthetic groups
(b) three - dimensional structure, especially the bond between amino acid residues that are distinct from each other in the polypeptide chain

- (c) linear sequence of amino acid residues in the polypeptide chain
 (d) regular folding patterns of continuous portions of the polypeptide chain.
29. Heat of neutralisation of CsOH with all strong acids is $13.4 \text{ kcal mol}^{-1}$. The heat released on neutralisation of CsOH with HF (weak acid) is $16.4 \text{ kcal mol}^{-1}$. ΔH° of ionisation of HF is Heat of neutralisation of strong acid with strong base = 13.7 kcal
 (a) 3.0 kcal (b) -3.0 kcal
 (c) 6.0 kcal (d) none of these.
30. The value of pK_w of water
 (a) increases with increase in temperature
 (b) decreases with rise in temperature
 (c) does not change with variation in temperature
 (d) increases till 50°C and there after decreases.
31. Which of the following statements is correct regarding the ions, Zn^{2+} , Ni^{2+} and Cr^{3+} ?
 (At. nos. $\text{Zn} = 30$, $\text{Ni} = 28$, $\text{Cr} = 24$)
 (a) Only Zn^{2+} is colourless, Ni^{2+} and Cr^{3+} are coloured.
 (b) All three are colourless.
 (c) All three are coloured.
 (d) Only Ni^{2+} is coloured, Zn^{2+} and Cr^{3+} are colourless.
32. When phenol is reacted with CHCl_3 and NaOH followed by acidification, salicylaldehyde is obtained. Which of the following species are involved in the above mentioned reaction as intermediate?
 (a)  (b) 
 (c)  (d) None of these.
33. The correct statement about the compounds A, B and C is
 (A)  (B) 
 (C) 
34. On passing a current of 1.0 ampere for 16 min and 5 sec through one litre solution of CuCl_2 , all copper of the solution is deposited at cathode. The strength of CuCl_2 solution is (Molar mass of $\text{Cu} = 63.5$, Faraday constant = 96500 C mol^{-1})
 (a) 0.07 M (b) 0.2 N
 (c) 0.005 M (d) 0.02 N
35. The nodal plane in the π -bond of ethene is located in
 (a) the molecular plane
 (b) a plane parallel to the molecular plane
 (c) a plane perpendicular to the molecular plane which bisects the carbon-carbon σ -bond at right angle
 (d) a plane perpendicular to the molecular plane which contains the carbon-carbon σ -bond.
36. Which of the following solutions will have pH close to 1.0 ?
 (a) 100 mL of $\text{M}/100 \text{ HCl}$ + 100 mL of $\text{M}/100 \text{ NaOH}$
 (b) 55 mL of $\text{M}/10 \text{ HCl}$ + 45 mL of $\text{M}/10 \text{ NaOH}$
 (c) 10 mL of $\text{M}/10 \text{ HCl}$ + 90 mL of $\text{M}/10 \text{ NaOH}$
 (d) 75 mL of $\text{M}/5 \text{ HCl}$ + 25 mL of $\text{M}/5 \text{ NaOH}$
37. Phosphate fertilizers when added to water leads to
 (a) increased growth of decomposers
 (b) reduced algal growth
 (c) increased algal growth
 (d) nutrient enrichment (eutrophication).
38. Consider the following haloalkanes :
 (1) CH_3I (2) CH_3F
 (3) CH_3Cl (4) CH_3Br
 The correct sequence of increasing order of dipole moments is
 (a) $1 < 2 < 3 < 4$ (b) $4 < 3 < 2 < 1$
 (c) $1 < 4 < 2 < 3$ (d) $3 < 4 < 1 < 2$
39. The most satisfactory method to separate mixture of sugars is
 (a) fractional crystallisation
 (b) sublimation (c) chromatography
 (d) Benedict's reagent.
40. Which of the following is most reactive towards electrophilic substitution?
 (a) Nitrobenzene
 (b) Aniline
 (c) Aniline hydrochloride
 (d) *N*-Acetylaniline

SOLUTIONS

1. (a): In a period, acidity of oxides increases from left to right.

2. (d): $\text{CH}_3\text{OH}_{(l)} + 3/2\text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + 2\text{H}_2\text{O}_{(l)}; \Delta H = ?$



$$\Delta H = 2\Delta H_2 + \Delta H_1 - \Delta H_3 = -726.4 \text{ kJ mol}^{-1}$$

Mol. wt. = 32 g mol^{-1} ; 32 g of CH_3OH gives 726.4 kJ

$\therefore 454 \text{ g}$ of CH_3OH gives 10305.8 kJ

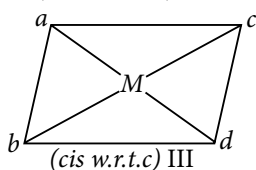
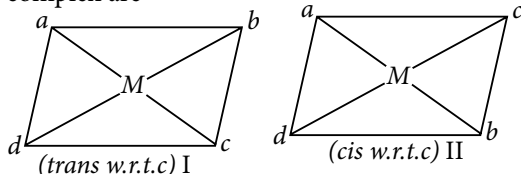
$$\therefore \Delta H = -10.3 \times 10^3 \text{ kJ}$$

3. (a):

Fe	Al	Br	
0.77V	-1.66V	1.08V	E°_{Red}
-0.77V	1.66V	-1.08V	E°_{Oxi}

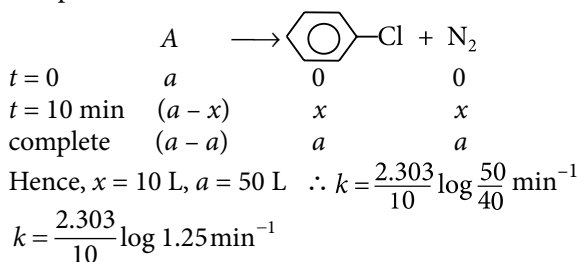
Hence, reducing power is $\text{Al} > \text{Fe}^{2+} > \text{Br}^-$.

4. (d): The three geometrical isomers of Mabcd planar complex are

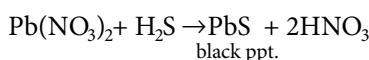
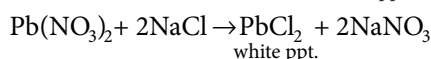


Isomers may be obtained by fixing the position of one ligand e.g., a , and placing at the *trans* position any one of the remaining three ligands one by one.

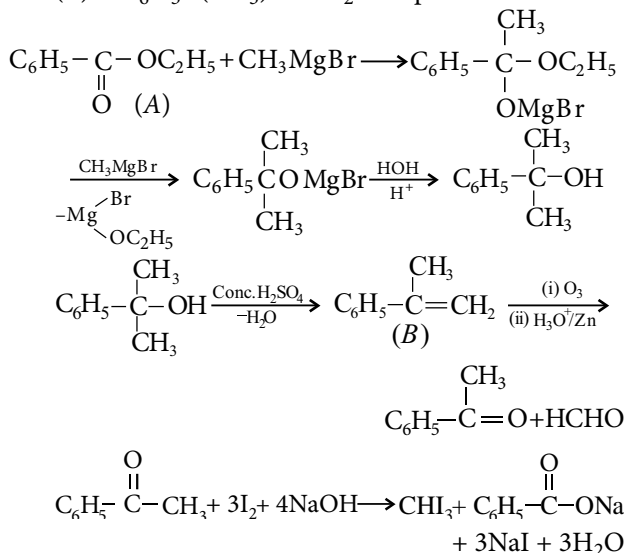
5. (b): It follows first order kinetics since half-life is independent of concentration.



6. (b): $\text{Pb}(\text{NO}_3)_2 + 2\text{NH}_4\text{OH} \rightarrow \text{Pb}(\text{OH})_2 + 2\text{NH}_4\text{NO}_3$

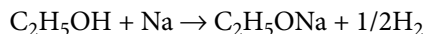


7. (a): Since ketone with molecular formula $\text{C}_8\text{H}_8\text{O}$ shows positive iodoform test, therefore, it must be a methyl ketone i.e., $\text{C}_6\text{H}_5\text{COCH}_3$. Since this ketone is obtained by the ozonolysis of an olefin (B) which is obtained by the addition of excess of CH_3MgBr to an ester (A) with molecular formula $\text{C}_9\text{H}_{10}\text{O}_2$, therefore, ester (A) is $\text{C}_6\text{H}_5\text{COOC}_2\text{H}_5$ and the olefin (B) is $\text{C}_6\text{H}_5\text{C}(\text{CH}_3)=\text{CH}_2$ as explained below:



8. (c): $\frac{r^+}{r^-} = 0.524$. It is in between $0.414 - 0.732$. Hence, coordination number is 6.

9. (c): Pure hydrogen is evolved by reacting absolute alcohol and Na.



Other statements are correct.

10. (b): Ease of liquefaction of noble gases increases down the group since van der Waals forces of attraction increase down the group with increasing atomic size. Thus, order of ease of liquefaction of noble gases is $\text{Xe} > \text{Kr} > \text{Ar} > \text{Ne} > \text{He}$.

11. (b): Since the ratio of p_A° and p_B° is 1 : 2 and mole fraction is 1 : 2 therefore,

partial pressure of A (p'_A) = $p_A^\circ x_A$ and

partial pressure of B (p'_B) = $p_B^\circ x_B$ are related as

$$p'_B = 4p'_A$$

$$P = p'_A + p'_B = p'_A + 4p'_A = 5p'_A$$

The mole fraction of A in the vapour in equilibrium with solution (according to Dalton's law of partial pressure) is

$$x'_A = \frac{p'_A}{P} = \frac{p'_A}{5p'_A} = \frac{1}{5} = 0.2$$

12. (c)

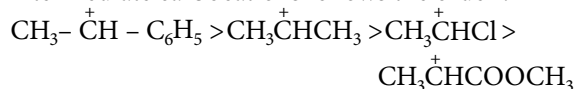
13. (d): Magnetic moment for an electron exists even if the orbital angular momentum is zero. This is explained by the spin magnetic moment because it is the spin which produces magnetic moment.

14. (b): 250 mg of X is present in 100 mL of colloidal sol of gold. By definition, gold number of X is that amount of it in mg which is present in 10 mL of colloidal gold solution. Hence, in 10 mL the amount of X present is 25 mg, which is the gold number of X.

15. (a): Depending upon the value of $T\Delta S$, ΔG can be lesser, equal or greater than ΔH .

16. (a)

17. (c): In cationic polymerization, carbocations are formed. Greater the stability of the carbocation, more reactive is the alkene. Since the stability of the intermediate carbocations follows the order :



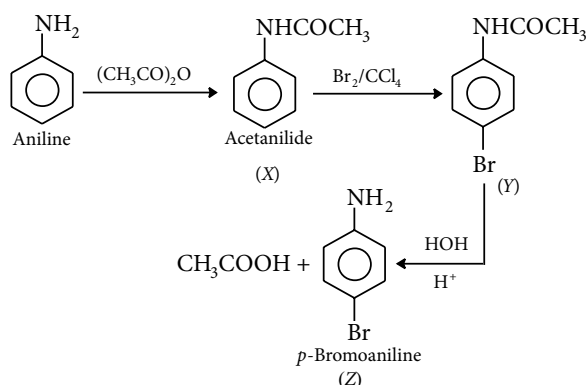
Therefore, reactivity decreases in the same order. Thus, styrene is most reactive.

18. (c): Arsenic drugs, also called arsenicols (like atoxyl, salvarsan, neoarsphenamine etc.) are mainly used in sleeping, sickness, syphilis etc.

19. (b): Elements X, Y, Z with atomic numbers 19, 37, 55 lie in group 1 (alkali metals). Within a group, IE decreases from top to bottom. Therefore, IE of Y could be between those of X and Z.

20. (b)

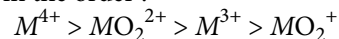
21. (a):



22. (a): $\Delta T_f = \frac{K_f \times w \times 1000}{M \times W}$

Other factors being constant the only factor M affects the ΔT_f . The smaller the molecular weight (M), the more is the ΔT_f .

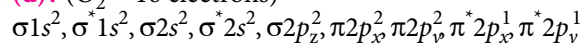
23. (c): The higher the charge on the metal ion, smaller is the ionic size and more is the complex forming ability. Thus, the degree of complex formation decreases in the order :



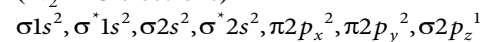
The higher tendency of complex formation of MO_2^{2+} as compared to M^{3+} is due to high concentration of charge on metal atom M in MO_2^{2+} .

24. (b)

25. (d): ($\text{O}_2 = 16$ electrons)

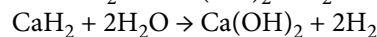
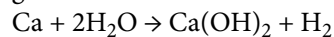


($\text{N}_2^+ = 13$ electrons)

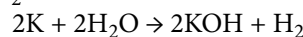


Thus, it contains one unpaired electron, hence paramagnetic.

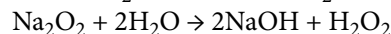
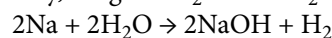
26. (c): Ca and CaH_2 both react with H_2O to form H_2 gas.



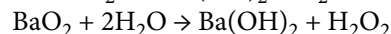
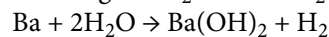
Whereas, K gives H_2 while KO_2 gives O_2 and H_2O_2 .



Similarly, Na gives H_2 while Na_2O_2 gives H_2O_2 .



Likewise Ba gives H_2 while BaO_2 gives H_2O_2 .

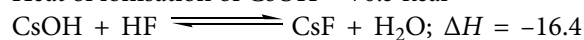


27. (a): By the use of Gabriel phthalimide synthesis, 1° alkyl halides can be converted into corresponding 1° amines.

28. (d)

29. (b): $\text{CsOH} + \text{H}^+ \rightarrow \text{Cs}^+ + \text{H}_2\text{O}$; $\Delta H = -13.4$ kcal

Heat of ionisation of $\text{CsOH} = +0.3$ kcal



kcal Heat of ionisation of $\text{HF} = x$ kcal

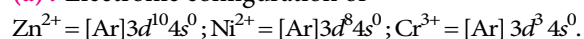
Heat of ionisation of $\text{CsOH} = 0.3$ kcal

Heat of neutralisation = -13.7 kcal

$$-13.7 + x + 0.3 = -16.4 \quad \text{or, } x = -3.0 \text{ kcal}$$

30. (b): On increasing temperature, K_w of water increases and hence $\text{p}K_w$ decreases.

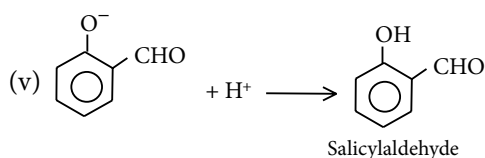
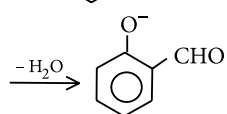
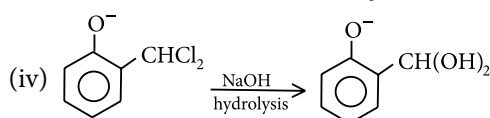
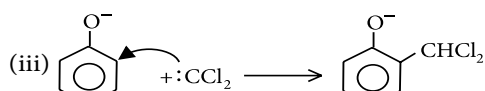
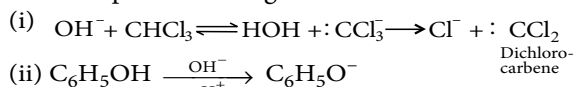
31. (a): Electronic configuration of



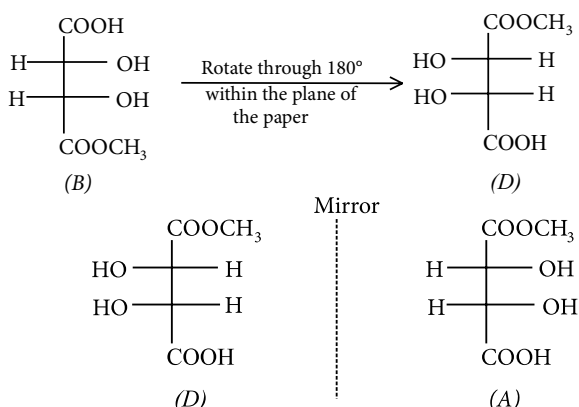
Hence, Zn^{2+} is colourless (no unpaired electrons),

Ni^{2+} and Cr^{3+} are coloured due to unpaired electrons.

32. (b): The given reaction is known as Reimer-Tiemann reaction. The formation of intermediates can be explained through its mechanism.



33. (d): Rotation of *B* through 180° within the plane of the paper gives *D* which is an enantiomer of (*A*).



Thus, *A* and *B* are enantiomers.

34. (c): $\text{Weight} = \frac{\text{Eq. wt.} \times It}{96500}$ [16 min 5 sec = 965 sec]

$$\text{Eq. wt.} = \frac{63.5}{2} = 31.75$$

$$\text{Mass deposited} = \frac{31.75 \times 1 \times 965}{96500} = 0.3175 \text{ g}$$

$$\text{Moles in one litre} = \frac{0.3175}{63.5} = 0.005 \text{ M}$$

35. (a): The molecular plane does not contain π -electron density, hence nodal plane in the π -bond is in the molecular plane.

36. (d): (a) Mixture of 100 mL of *M*/100 HCl and 100 mL of *M*/100 NaOH is an exact neutralisation. Hence pH = 7.

(b) After neutralisation, *M*/10 HCl left = 10 mL

Total volume = 100 mL, dilution = 10 times

$$\therefore [\text{H}^+] = 10^{-2} \text{ or pH} = 2$$

(c) After neutralisation, *M*/10 NaOH left = 80 mL

Total volume = 100 mL ; pH > 7

(d) After neutralisation, *M*/5 HCl left = 50 mL

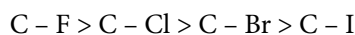
Total volume = 100 mL, dilution = 2 times

$$\therefore [\text{H}^+] = \frac{1}{10} = 10^{-1} \text{ or pH} = 1$$

37. (d): Addition of phosphate fertilizers to water leads to nutrient enrichment (eutrophication).

38. (c): $\text{CH}_3\text{I} < \text{CH}_3\text{Br} < \text{CH}_3\text{F} < \text{CH}_3\text{Cl}$
 1.6 D 1.79 D 1.84 D 1.94 D

The charge separation in C – X bond decreases in the order :



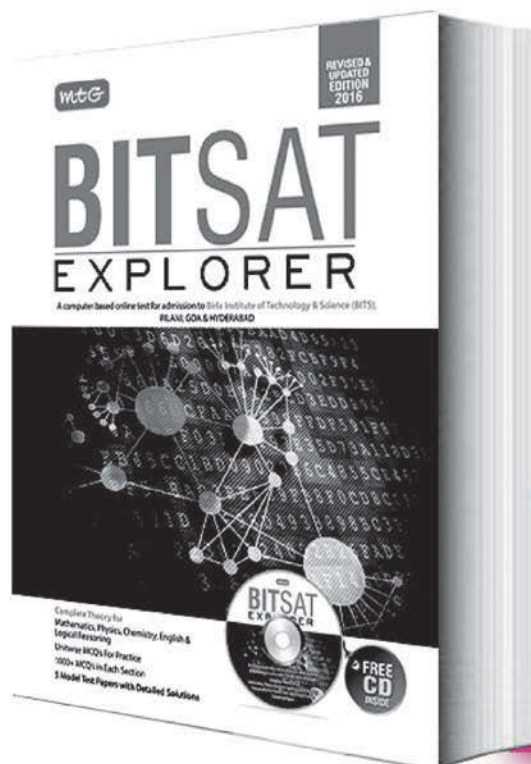
due to decrease in the electronegativity as we move from F \rightarrow Cl \rightarrow Br \rightarrow I. CH_3Cl has higher dipole moment than CH_3F because of larger bond length of C – Cl bond. The larger C – Cl bond length causes dipole moment ($\mu = q \times d$) to be larger for CH_3Cl than CH_3F . In case of other haloalkanes, the effect of larger C – X bond length cannot outweigh the effect of decreased charge separation.

39. (c): The mixture of sugars is a homogeneous one. Homogeneous mixtures of a solvent and one or more solutes (dissolved substances) are often separated by chromatography. Chromatography works to separate a mixture because the components of a mixture distribute themselves differently when they are in contact with a “two phase system”. One phase is stationary and the other is moving or mobile. The stationary phase may be a solid packed in a tube or a piece of paper. The mobile phase may be liquid or gaseous.

40. (b): Amongst nitrobenzene, aniline, aniline hydrochloride and *N*-acetylaniline only aniline has electron donating $-\text{NH}_2$ group. As a result, electron density on the benzene ring increases and hence it becomes reactive towards electrophilic substitution reactions.



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

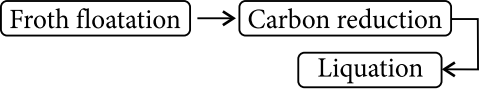
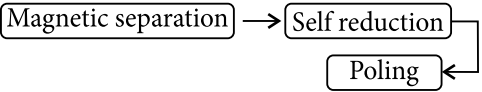
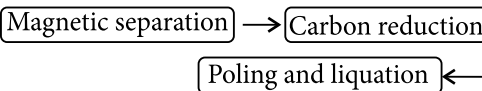
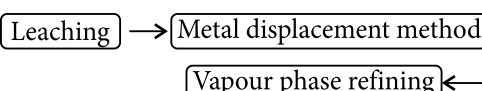
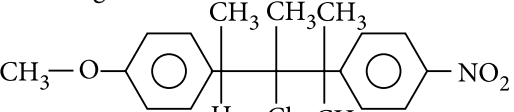
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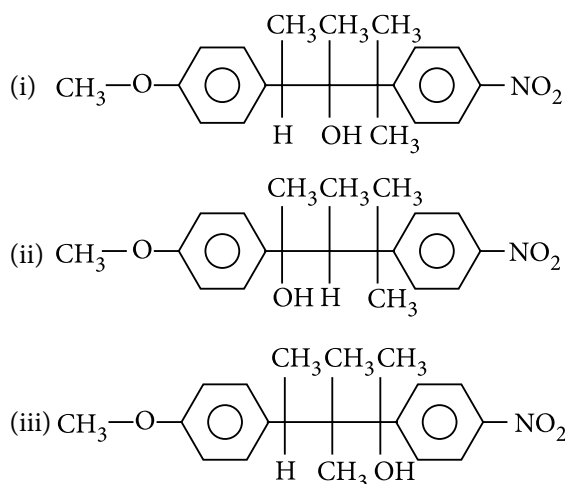
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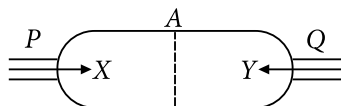


- 200 mL of an aqueous solution of glucose ($C_6H_{12}O_6$) has molarity of 0.01 M. Which of the following operations can be done to this solution so as to increase molarity to 0.015 M?
 (a) Evaporate 50 mL of water from this solution.
 (b) Add 0.18 g glucose to solution without changing its volume.
 (c) Add 50 mL of water to this solution.
 (d) None of the above.
- The most stable carbocation is
 (a)  (b) 
 (c)  (d) 
- Number of nodal plane(s) in the π bonding molecular orbital is
 (a) 0 (b) 1
 (c) 2 (d) 3
- 4.08 g of a mixture of BaO and unknown carbonate (MCO_3) was heated strongly. The residue 3.64 g was dissolved in 1000 mL of 1N HCl. The excess acid required 16 mL of 2.5 N NaOH solution for complete neutralisation. Which of the following is the metal M ?
 (a) K (b) Na
 (c) Ca (d) Cu
- Which of the following molecules has a *meso* stereoisomer?
 (a) 2 - Bromo - 4 - chloropentane
 (b) *trans*-2-Hexene
 (c) 1,4 - Dichloropentane
 (d) 3, 4 - Dichlorohexane
- Element A has three allotropic forms α , β and γ . All of these exist as cyclo-octaatomic ring type structures. Calculated oxidation state of A in an oxyacid is +8 while its actual oxidation state is +6. What will be the hybridisation of element A in that particular oxyacid?
 (a) sp (b) sp^2 (c) sp^3 (d) sp^3d^2
- A solution of weak acid is titrated with base NaOH. The equivalence point is reached when 36.12 mL of 0.1 M NaOH has been added. Now, 18.06 mL of 0.1 M HCl is added to the titrated solution and the pH changes to 4.92. What is the value of K_a of weak acid?
 (a) 1.2×10^{-4} (b) 3.2×10^{-6}
 (c) 1.2×10^{-5} (d) 3.0×10^{-4}
- Which of the following diagrams is correctly related to different steps involved in the extraction of Sn from cassiterite ore?
 (a) 
 (b) 
 (c) 
 (d) 
- The given compound on hydrolysis in aqueous acetone will give




- (a) mixture of (i) and (ii)
 (b) mixture of (i) and (iii)
 (c) only (iii)
 (d) only (i)

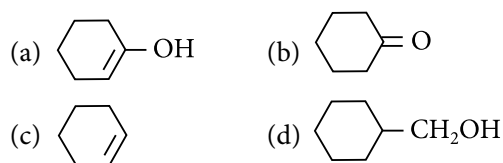
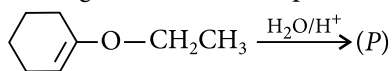
10. 1 mole of gas "X" and 2 moles of gas "Y" enter from the end "P" and "Q" of the cylinder respectively, as shown in the given diagram.



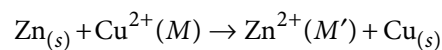
The length of the cylinder is 150 cm. The gas "X" intermixes with gas "Y" at the point A. If the molecular weights of the gases X and Y are 20 and 80 respectively, then what will be the distance of point A from Q?

- (a) 75 cm (b) 50 cm
 (c) 100 cm (d) 90 cm

11. A complex (X) with empirical formula $\text{PtCl}_2 \cdot 2\text{NH}_3$ shows the conductivity but does not produce AgCl when treated with $\text{AgNO}_3(\text{aq})$. There is no geometrical isomer for (X). Select the correct statement for (X).
- (a) It is paramagnetic
 (b) Formula of (X) is $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]^0$
 (c) The given complex is $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}_2$ and oxidation numbers of Pt = +4
 (d) Name of complex is tetraammineplatinum(II) tetrachloridoplatinate(II)
12. In the given reaction, the product P is

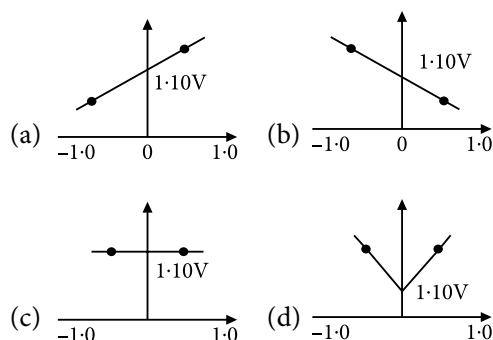


13. Which graph correctly correlates E_{cell} with the function of concentrations, for the cell (for different values of M and M')



$E_{\text{cell}}^{\circ} = 1.10 \text{ V}$

X-axis : $\log \frac{[\text{Zn}^{2+}]}{[\text{Cu}^{2+}]}$, Y-axis : E_{cell}



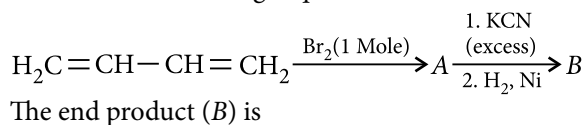
14. The reaction of an element A with water produces combustible gas B and an aqueous solution of C. When another substance D reacts with the solution of C, it also produces the gas B. D also produces the same gas even on reaction with dilute H_2SO_4 at room temperature. Element A imparts golden yellow colour to Bunsen flame. Then A, B, C and D may be identified as

- (a) Na, H_2 , NaOH and Zn
 (b) K, H_2 , KOH and Zn
 (c) K, H_2 , NaOH and Zn
 (d) Ca, H_2 , CaCO_3 and Zn

15. 1 litre of a mixture of CO and CO_2 is taken. When this mixture is passed through a tube containing red hot charcoal, the volume becomes 1.6 litre. If the volumes are measured under the same condition the amount of CO_2 by volume is

- (a) 1.2 L (b) 1 L
 (c) 0.6 L (d) 0.4 L

16. Consider the following sequence of reactions :



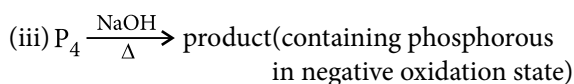
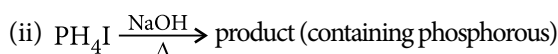
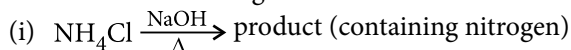
- (a) $\text{H}_2\text{N}-(\text{CH}_2)_2-\text{CH}=\text{CH}-(\text{CH}_2)_2-\text{NH}_2$
 (b) $\text{H}_2\text{N}-(\text{CH}_2)_6-\text{NH}_2$
 (c) $\text{NC}-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-\text{CN}$
 (d) $\text{H}_2\text{C}=\text{CH}-\underset{\text{NH}_2}{\text{CH}}-(\text{CH}_2)_2-\text{NH}_2$

17. 50 students are sitting in a room of $5 \times 10 \times 3 \text{ m}^3$ dimensions. The air inside the room is at 27°C and 1 atm pressure. If each student loses 100 watt heat per second assuming the walls, ceiling, floor and all the material present inside the room is perfectly insulated as well as neglecting loss of air to outside as the temperature is raised, how much rise in temperature will be noticed in 10 minutes?

(Given $C_p = \frac{7}{2} R$ for air).

- (a) 15.20 (b) 13.91 (c) 16.90 (d) 18.20

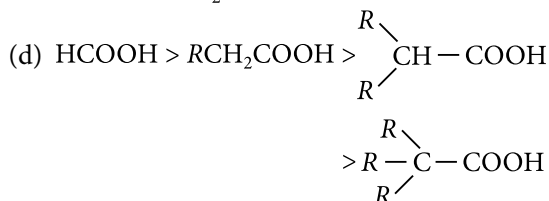
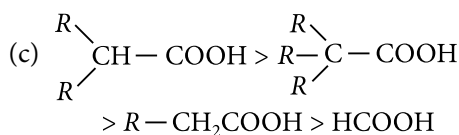
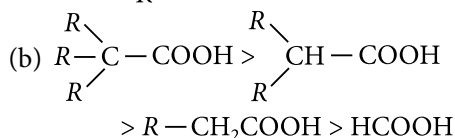
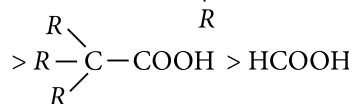
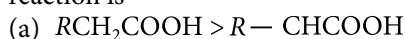
18. Consider the following reactions:



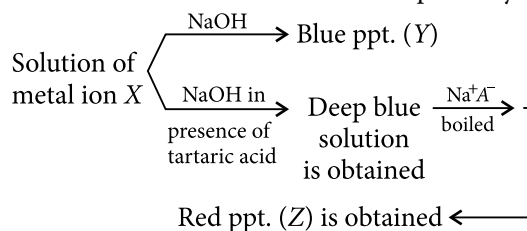
The order of change in bond angle (for reactant \rightarrow specified product) is

- (a) (i) > (ii) > (iii) (b) (ii) > (iii) > (i)
 (c) (iii) > (ii) > (i) (d) (ii) > (i) > (iii)

19. The reactivity of carboxylic acids for esterification reaction is



20. The cation X and the anion A are respectively

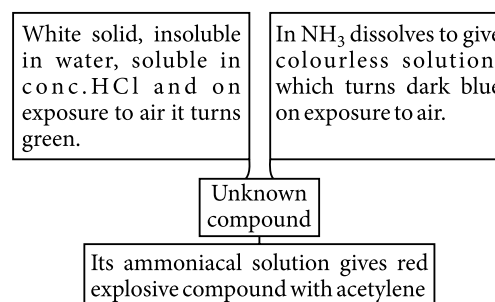


- (a) NH_4^+ , CH_3CO_2^- (b) HCO_2^- , Cu^{2+}
 (c) Pb^{2+} , $\text{C}_2\text{O}_4^{2-}$ (d) Cu^{2+} , HCO_2^-

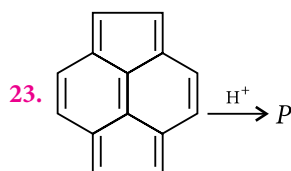
21. There is a stream of neutrons with a kinetic energy of 0.0327 eV. If the half life of neutrons is 700 seconds, what fraction of neutrons will decay before they travel a distance of 10 km? (Mass of neutron = $1.675 \times 10^{-27} \text{ kg}$)

- (a) 0.2% (b) 1.1%
 (c) 0.4% (d) 1.2%

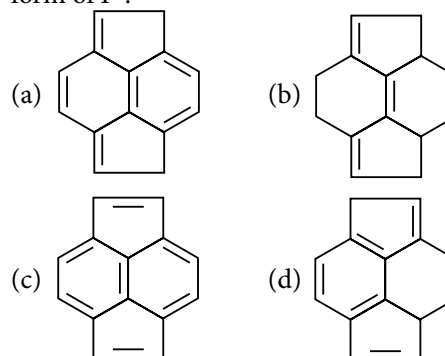
22. Identify the unknown compound.



- (a) NaCl (b) NiCl_2
 (c) Cu_2Cl_2 (d) FeSO_4



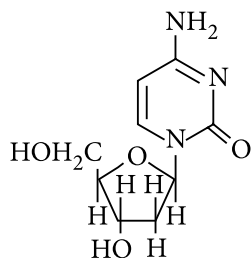
Which of the following represents the most stable form of P?



24. The percentage vacant space in one layer of square packing of spheres touching each other having 4 spheres is

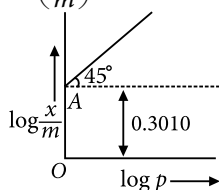
- (a) $\frac{3}{8}\pi \times 100$ (b) $100 - \frac{\pi}{6}$
(c) $\frac{3}{8}\pi$ (d) $100 - \frac{\pi}{6} \times 100$

25. Consider the following structure of a nucleoside and select the correct statement.

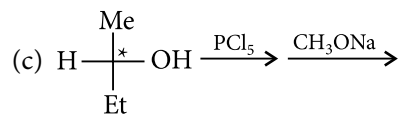
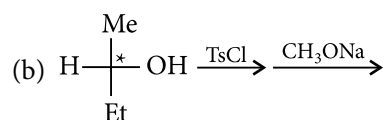
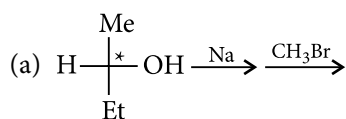


- (a) It represents an amino acid joined to sucrose.
(b) It represents β -glycosides of *D*-ribofuranose.
(c) It represents β -glycosides of *D*-deoxyribofuranose.
(d) It represents α -glycosides of *D*-ribofuranose.
26. A first order reaction $A \rightarrow B$ requires activation energy of 70 kJ mol^{-1} . When a 20% solution of *A* was kept at 25°C for 20 minutes, 25% decomposition took place. What will be the percentage decomposition in the same time in a 30% solution maintained at 40°C ? Assume that the activation energy remains constant in this range of temperature.
- (a) 82.40% (b) 53.52%
(c) 67.21% (d) 11.11%

27. Graph between $\log\left(\frac{x}{m}\right)$ and $\log p$ is a straight line at an angle of 45° with the intercept *OA* as shown in the figure. Hence, $\left(\frac{x}{m}\right)$ at a pressure of 0.2 atm is



- (a) 0.2 (b) 0.4 (c) 0.6 (d) 0.8
28. In which of the following cases, configuration about chiral C^* is retained?



- (d) None of these

29. Which of the following electronic configurations have zero spin multiplicity?

- (a) $\uparrow\uparrow\uparrow$ (b) $\uparrow\uparrow\downarrow$
(c) $\uparrow\downarrow\downarrow$ (d) $\downarrow\downarrow\downarrow$

30. The rate of an enzyme-catalyzed reaction was measured using several substrate concentrations that were much lower than K_m . The dependence of reaction velocity on substrate concentration can best be described as
- (a) independent of enzyme concentration
(b) a constant fraction of V_{max}
(c) equal to K_m
(d) proportional to the substrate concentration.

ANSWER KEYS

1. (b) 2. (d) 3. (b) 4. (c) 5. (d)
6. (c) 7. (c) 8. (c) 9. (a) 10. (a)
11. (d) 12. (b) 13. (b) 14. (a) 15. (c)
16. (b) 17. (c) 18. (c) 19. (d) 20. (d)
21. (c) 22. (c) 23. (c) 24. (d) 25. (c)
26. (c) 27. (b) 28. (a) 29. (c) 30. (d)



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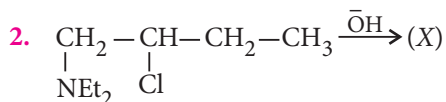
PRACTICE PAPER 2016

PAPER-1

SECTION I

This section contains 9 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which only one is correct. For each question you will be awarded 3 marks if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, minus one (–1) mark will be awarded.

1. The IUPAC name of *iso*-octane is
(a) 2-methylheptane (b) 2-methyloctane
(c) 2,4-dimethylhexane
(d) 2,2,4-trimethylpentane.



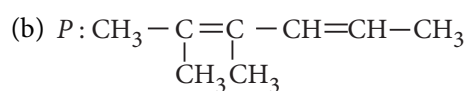
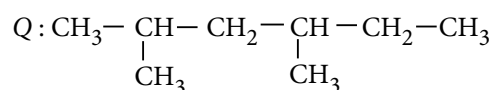
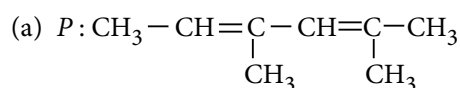
Major product (66.2% carbon) 'X' can be

- (a) $\text{CH}_2 - \underset{\text{NEt}_2}{\underset{|}{\text{CH}}} - \underset{\text{OH}}{\underset{|}{\text{CH}_2}} - \text{CH}_3$
(b) $\text{CH}_2 - \underset{\text{OH}}{\underset{|}{\text{CH}}} - \underset{\text{NEt}_2}{\underset{|}{\text{CH}_2}} - \text{CH}_3$
(c) $\text{CH}_2 - \underset{\text{NEt}_2}{\underset{|}{\text{CH}}} = \text{CH} - \text{CH}_3$
(d) $\text{CH}_2 = \underset{\text{NEt}_2}{\underset{|}{\text{C}}} - \text{CH}_2 - \text{CH}_3$

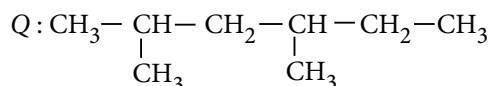
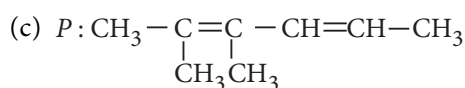
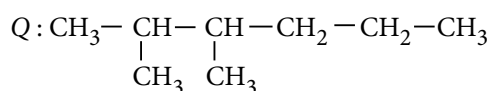
3. During one of his adventures, Chacha Chaudhary got trapped in an underground cave which was sealed two hundred years back. The air inside was poisonous containing CO in addition to O₂ and N₂. Sabu, being huge, could not enter cave. In order to save Chacha Chaudhary he started sucking the poisonous air out of the cave by mouth. In each cycle he used to fill his lungs with cave air and exhale

it out in the surroundings. In the mean time fresh air (N₂ + O₂) from the surroundings effused into cave till the pressure was 1 atmosphere. Each time Sabu sucked air, the pressure in the cave dropped to 1/2 atm. An initial sample of air taken from the cave measured 11.2 mL at STP and gave 7 J on complete combustion at constant pressure.

- (i) If the safe level of CO required in cave for life is less than 0.001% by volume, how many times does Sabu need to suck out air in order to save Chacha Chaudhary?
(ii) Sabu should rescue Chacha Chaudhary within 10 minutes else he will die. Precious 80 seconds were wasted in thinking of a way to rescue him. At maximum, how much time should each cycle of inhaling and exhaling take?
[Given : $\Delta H_{\text{comb}} \text{CO} = -280 \text{ kJ mol}^{-1}$. Neglect Graham's law effect during operations.]
(a) 8 times, 20 seconds (b) 13 times, 40 seconds
(c) 8 times, 40 seconds (d) 13 times, 20 seconds
4. An organic compound (P) (C = 87.2%, H = 12.8 %) on catalytic reduction gave (Q) (C = 84.1%, H = 15.9%). Oxidative ozonolysis of (P) gave acetic acid, acetone and pyruvic acid (CH₃—CO—COOH). Identify (P) and (Q).



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(d) Both (a) and (b)

5. When any chloride is heated with conc. H_2SO_4 , then HCl is obtained while when any bromide is heated with conc. H_2SO_4 , then Br_2 is obtained and not HBr. This is because
 (a) HCl is a gas while HBr is a liquid
 (b) HCl is a liquid while HBr is a gas
 (c) HBr is a stronger reducing agent than HCl
 (d) Br_2 is a liquid and HCl is a gas.
6. 0.001 mol of $\text{Cr}(\text{NH}_3)_5(\text{NO}_3)\text{SO}_4$ was passed through cation exchanger and the acid coming out of it required 20 mL of 0.1 M NaOH for neutralization. Hence the complex is
 (a) $[\text{Cr}(\text{NH}_3)_5(\text{NO}_3)](\text{SO}_4)$
 (b) $[\text{Cr}(\text{NH}_3)_5(\text{SO}_4)](\text{NO}_3)$
 (c) $[\text{Cr}(\text{NH}_3)_4(\text{NO}_3)(\text{SO}_4)](\text{NH}_3)$
 (d) $[\text{Cr}(\text{NH}_3)_5](\text{NO}_3)(\text{SO}_4)$
7. Which one of the following expressions represents the electron probability function D ?
 (a) $4\pi r dr \psi^2$ (b) $4\pi r^2 dr \psi$
 (c) $4\pi r^2 dr \psi^2$ (d) $4\pi r dr \psi$
8. The vapour pressure of hexane (C_6H_{14}) and heptane (C_7H_{16}) at 50°C are 408 Torr and 141 Torr respectively. The composition of the vapour above a binary solution containing a mole fraction of 0.300 hexane is
 (a) $y_{\text{hexane}} = 0.8, y_{\text{heptane}} = 0.2$
 (b) $y_{\text{hexane}} = 0.554, y_{\text{heptane}} = 0.446$
 (c) $y_{\text{hexane}} = 0.300, y_{\text{heptane}} = 0.700$
 (d) $y_{\text{hexane}} = 0.871, y_{\text{heptane}} = 0.129$
9. For the reaction,

$$\text{H}_{2(g)} + 2\text{AgCl}_{(s)} + 2\text{H}_2\text{O}_{(l)} \longrightarrow 2\text{Ag}_{(s)} + 2\text{H}_3\text{O}^+_{(aq)} + 2\text{Cl}^-_{(aq)}$$

 At 25°C , the standard free energy of formation of $\text{AgCl}_{(s)}$, $\text{H}_2\text{O}_{(l)}$ and $(\text{H}_3\text{O}^+ + \text{Cl}^-)_{(aq)}$ are -109.7 , -237.2 and -368.4 kJ/mol. What will be the cell voltage if this reaction is run at 25°C and one

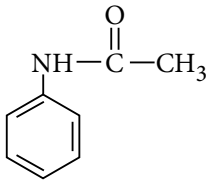
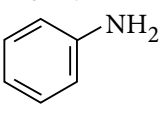
atmosphere in a cell in which H_2 activity is unity and $\text{H}_3\text{O}^+_{(aq)}$ and $\text{Cl}^-_{(aq)}$ activities are each at 0.01 M?

- (a) 0.082 volt (b) 0.231 volt
 (c) 0.458 volt (d) 1.26 volt

SECTION II

This section contains 5 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which one or more than one answer is correct. For each question you will be awarded 4 marks if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. No negative marking in this section.

10. Which of the following statements is/are correct?
 (a) I^- is a better leaving group than Cl^- .
 (b) In polar aprotic solvent, the nucleophilicity order for $\text{S}_{\text{N}}2$ reaction is $\text{F}^- > \text{Cl}^- > \text{Br}^- > \text{I}^-$.
 (c) The reactivity order of electrophilic addition reaction is alkene $>$ alkyne because the transition state formed for alkene has lesser energy than that for alkyne.
 (d) CH_3COO^- is a better leaving group than CH_3SO_3^- .
11. Which of the following statements is/are correct?
 (a) The *meta*-position in nitrobenzene undergoes electrophilic substitution reaction because it is less deactivated when compared to *ortho* and *para*-positions in nitrobenzene.
 (b) When *D*-glucose is treated with sodium borohydride, optically active glucitol is formed.

- (c) The benzene ring in  is slightly deactivated than the benzene ring in .
- (d) CF_3^\oplus is more stable than $\text{CF}_3\text{CH}_2^\oplus$.

12. Which of the following reactions are not acceptable for glucose?
 (a) Reaction with PhNHNH_2
 (b) Reaction with NaHSO_3
 (c) Reaction with RMgX
 (d) Reaction with HCN

13. K_2MnO_4 is formed when
- Cl_2 is passed into an aqueous $KMnO_4$ solution
 - MnO_2 is fused with KOH in air
 - $HCHO$ reacts with alkaline $KMnO_4$
 - $KMnO_4$ reacts with conc. H_2SO_4 .
14. Which of the following statements is/are consistent with the properties of a molecular solid?
- A low melting solid.
 - A compound that conducts electricity when molten.
 - A solid that is a non-conductor of electricity.
 - A solid formed by the combination of two non-metallic elements.

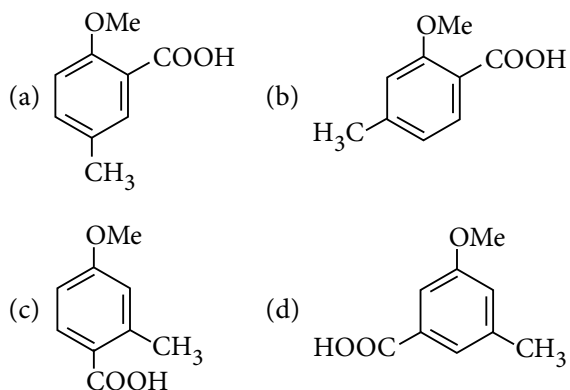
SECTION-III

This section contains 3 paragraph type questions. Based upon the paragraph, 2 multiple choice questions have to be answered. Each question has 4 choices (a), (b), (c) and (d), out of which only one is correct. For each question you will be awarded 3 marks if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, minus one (-1) mark will be awarded.

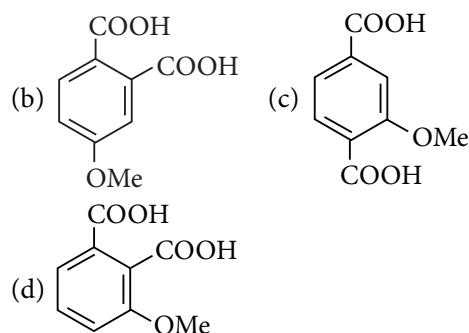
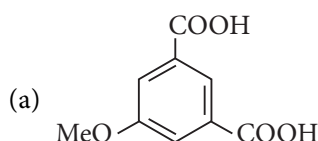
Paragraph for Q. Nos. 15 to 16

Organic compound A ($C_{10}H_{12}O_2$) is a neutral compound and gives positive iodoform test. 'A' when treated with hot alkaline $KMnO_4$ gives B ($C_9H_8O_5$) which readily forms anhydride on heating. 'B' when heated with sodalime gives 'C' which when treated with aqueous HI gives phenol as one of the products. Based on the above facts, answer the following ;

15. (A) $\xrightarrow[H_2O]{I_2/NaOH}$ (X) + CHI_3 . Product 'X' can be



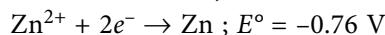
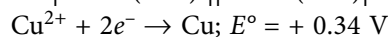
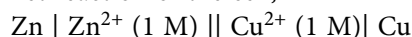
16. Structure of B is



Paragraph for Q. Nos. 17 to 18

In the galvanic cell, Zn rod is the oxidation electrode. It is immersed in 100 mL, 1M $Zn(NO_3)_2$ aqueous solution that pumps electrons into the external circuit and as a result it loses weight. At the same time, Cu electrode in 100 mL of 1 M $Cu(NO_3)_2$ aqueous solution gains weight due to reduction.

When the cell is maintained at steady temperature $25^\circ C$ the net reaction of the cell,



But when the cell is operated as an electrolysis cell for 10 hours by a current of 0.4825 ampere then

$$\left(\text{Given: } \frac{0.4825 \times 36000}{96500} = 0.18 \right)$$

17. mole of Zn^{2+} removed
- 0.09
 - 0.07
 - 0.08
 - 1.75
18. mole of Cu^{2+} present after electrolysis
- 0.25
 - 0.19
 - 0.09
 - 1.25

Paragraph for Q. No. 19 & 20

Portland cement :

It was first discovered in England. It is essentially a mixture of lime stone and clay. It was called Portland cement because in presence of water it sets to a hard stone-like mass resembling with the famous Portland rock, a famous building stone of England. The approximate composition of Portland cement is

Calcium oxide (CaO)	62%
Silica (SiO_2)	22%
Alumina (Al_2O_3)	7.5%
Magnesia (MgO)	2.5%
Ferric oxide (Fe_2O_3)	2.5%

The above compounds are provided by the two raw materials, namely lime stone (which provides CaO) and clay which provides SiO_2 , Al_2O_3 and Fe_2O_3 . In

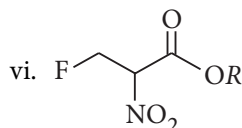
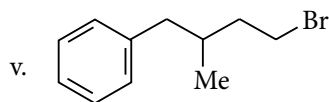
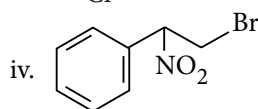
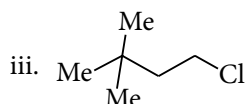
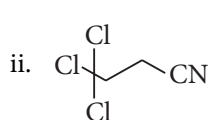
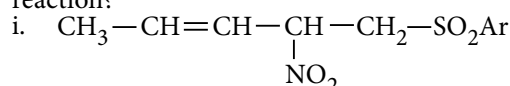
cement, almost entire amount of lime is present in the combined state as calcium silicates ($2\text{CaO} \cdot \text{SiO}_2$ and $3\text{CaO} \cdot \text{SiO}_2$) and calcium aluminates ($3\text{CaO} \cdot \text{Al}_2\text{O}_3$ and $4\text{CaO} \cdot \text{Al}_2\text{O}_3$).

19. Cement with high heat of hydration is
 (a) alite (b) belite
 (c) silite (d) ferite.
20. Cement with low heat of hydration is
 (a) alite (b) belite
 (c) silite (d) ferite.

SECTION-IV

This section contains 8 integer type questions. Answers are to be given in between 0 to 9 in the form of nearest integer. Each question carries 4 marks if you darken the correct answer and no negative mark will be awarded for an incorrectly bubbled answer.

21. How many of the following compounds give $\text{E}_{1-\text{cb}}$ reaction?

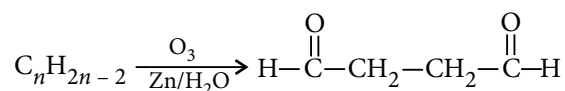
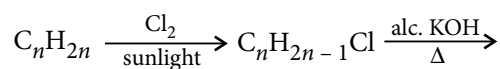


22. The lowest boiling point is expected for
 [1] *iso*-octane [2] *n*-octane
 [3] 2,2,3-trimethylbutane
 [4] *n*-heptane [5] nonane
 [6] decane.

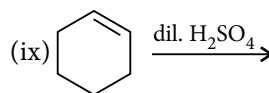
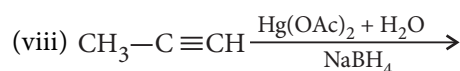
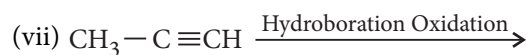
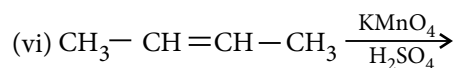
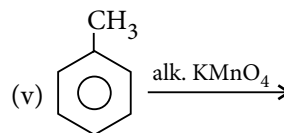
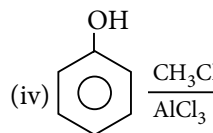
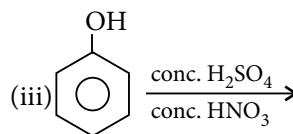
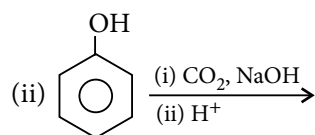
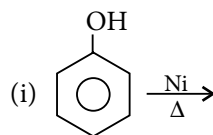
23. When 1-chloromethyl-4-methyl-1, 3-cyclopentadiene (A) is solvolysed in aqueous medium, x isomeric alcohols (excluding stereoisomers) are obtained. Find 'x'.

24. Among the following, the total number of compounds which are diamagnetic in nature is
 O_2^- , CN^- , CO , NO^+ , O_2 , O_2^{2-} , N_2 , N_2^+ , N_2^-

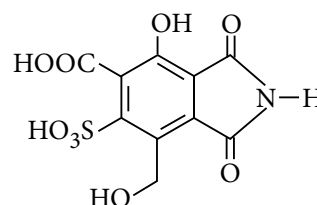
25. Sodium adipate, on electrolysis gives cycloalkane, C_nH_{2n} . Find 'n'.



26. Among the following the number of the reaction(s) in which product is more acidic than phenol?



27. If one mole of the following compound is treated with NaOH solution, how many moles of NaOH would be required for complete neutralization.

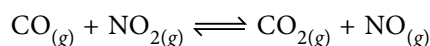


28. The number of six membered and five membered carbon rings in the structure of Buckminster fullerene (i.e., C_{60}) are x and y . Find the value of $x - y$.

SECTION I

This section contains 4 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which only one is correct. For each question you will be awarded 3 marks if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, minus one (1) mark will be awarded.

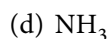
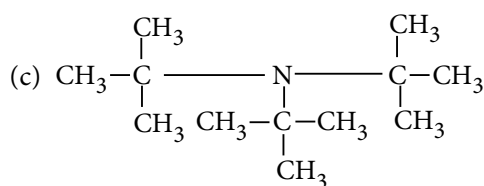
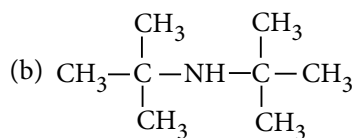
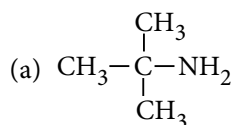
1. At a certain temperature the following equilibrium is established



One mole of each of the four gases is mixed in one litre container and the reaction is allowed to reach equilibrium state. When excess of baryta water $\text{Ba}(\text{OH})_2$ is added to the equilibrium mixture, the weight of white ppt. (BaCO_3) obtained is 236.4 g. The equilibrium constant K_c of the reaction is [$\text{Ba} = 137$]

- (a) 1.2 (b) 2.25
(c) 2.1 (d) 3.6

2. Which one of the following is the weakest base?



3. Which of the following is not correct?
- Physical adsorption is due to van der Waals' forces.
 - Chemical adsorption decreases initially on increasing temperature and pressure.
 - Physical adsorption is reversible.
 - Adsorption energy for a chemical adsorption is generally greater than that of physical adsorption.

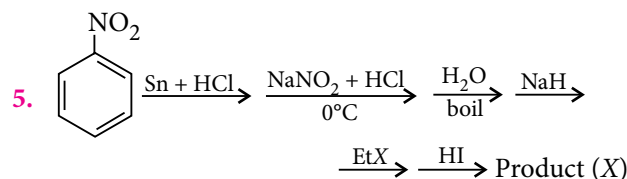
4. $\text{CaC}_2 \xrightarrow[-\text{Ca}(\text{OH})_2]{\text{H}_2\text{O}} (\text{P}) \xrightarrow[\text{NH}_4\text{Cl}]{\text{Cu}_2\text{Cl}_2} (\text{Q}) \xrightarrow{\text{HCl}} (\text{R})$
 $\xrightarrow{\text{polymerisation}} (\text{S})$. Compound S is
 (a) chloroprene (b) buna-N
 (c) natural rubber (d) neoprene.

SECTION II

This section contains 3 paragraph type questions. Based upon the paragraph, 3 multiple choice questions have to be answered. Each question has 4 choices (a), (b), (c) and (d), out of which only one is correct. For each question you will be awarded 3 marks if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, minus one (-1) mark will be awarded.

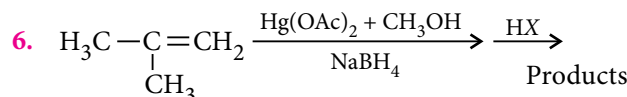
Paragraph for Q. Nos. 5 to 7

Carbon-oxygen bond in ethers can be cleaved by halogen acid (HX) where the product can be a mixture of alcohol and alkyl halide. However, when excess halogen acid (HX) is used only alkyl halide can be produced. The order of reactivity of HX towards $\text{R}-\text{O}-\text{R}'$ is $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$.



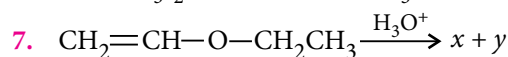
The product (X) is

- (a) PhOH (b) $\text{CH}_3\text{CH}_2\text{OH}$
(c) PhI (d) Both (b) and (c).



The alcohol as a major product is obtained as

- (a) $(\text{CH}_3)_3\text{COH}$ (b) $\text{CH}_3\text{CH}_2\text{OH}$
(c) $(\text{CH}_3)_2\text{CHOH}$ (d) CH_3OH

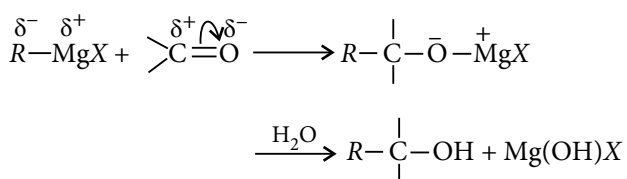


The similar test given by both x and y can be

- (a) Lucas test (b) iodoform test
(c) Victor Meyer's test
(d) all of them.

Paragraph for Q. Nos. 8 to 10

Grignard reagent (RMgX) acts as a strong nucleophile as well as base. The most useful nucleophilic addition reaction is the addition of RMgX to carbonyl compounds.



The reactivity of compounds towards S_N depends upon the leaving group ability.

8. Which of the following compounds does not give acid-base reaction with $RMgX$?
- (a) $CH_3CH_2NO_2$ (b) CH_3OH
 (c) CH_3CH_2Cl (d) H_2S
9. Which of the following gives racemic mixture on reaction with CH_3MgBr ?
- (a) $HCHO$ (b) CH_3COCH_3
 (c) $PhCHO$ (d) CH_3COCl
10. In the following groups,
- I. $-OAc$ II. $-OMe$
 III. $-OSO_2Me$ IV. $-OSO_2CF_3$
 the order of leaving group ability is
- (a) $I > II > III > IV$ (b) $IV > III > I > II$
 (c) $III > II > I > IV$ (d) $II > III > IV > I$

Paragraph for Q. Nos. 11 to 13

(i) Metal (M) $\xrightarrow[\text{in dil. } H_2SO_4]{\text{Dissolves}}$ pale green solution (A)

↓ add alkali

whitish precipitate quickly turning brown and dissolves with dil. HCl giving yellow solution (B)

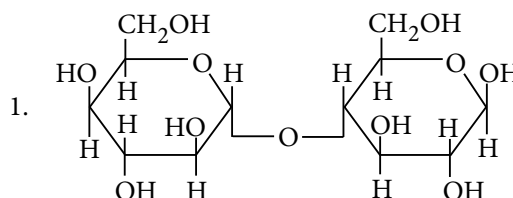
(ii) Black substance $\xrightarrow[\text{air with } Na_2CO_3]{\text{heated in}}$ dark mass
 (C) ↓ extracted with water
 pink solution $\xleftarrow[\text{water}]{\text{chlorine}}$ green solution
 (E) (D)

11. The green coloured substance formed in series (ii) is
- (a) K_2MnO_4 (b) Na_2MnO_4
 (c) $KMnO_4$ (d) $NaMnO_4$
12. The metal (M) in reaction series (i) is
- (a) Mn (b) Fe (c) Sn (d) Hg
13. The yellow coloured solution in series (i) and the compound (C) in series (ii) are
- (a) $FeCl_3$ and MnO_2 (b) $FeCl_2$ and MnO_4^-
 (c) $FeSO_4$ and Mn
 (d) $Fe(SCN)_3$ and MnO_4^{2-}

SECTION III

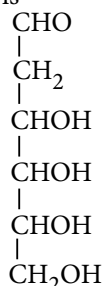
This section contains 5 integer type questions. Answers are to be given in between 0 and 9. For each question you will be awarded 4 marks if you have darkened the bubble corresponding to the correct answer and zero mark if no bubble is darkened. No negative marking in this section.

14. A nitrogen containing compound when heated with excess of $NaOH$ gives gas NH_3 . The gas NH_3 is absorbed in 1.628 litres of 1 N H_2SO_4 . The excess of acid is completely neutralized by 1.270 litres of 1 N $NaOH$ solution. Calculate the weight (in gram) of gas present in the solution.
15. Read the following statements from 0 to 9 and out of which ONLY ONE statement is WRONG and mark the correct code in the ORS.
0. Both glucose and fructose give positive test with Tollens' reagent.

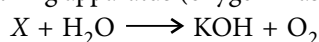


- give positive test with Tollens' reagent.
2. Thermosetting polymers are the polymers which undergo permanent change on heating.
3. A polymer formed by the condensation of two or more than two monomers with the elimination of simple molecules like water, ammonia, hydrogen chloride, alcohol, etc. is called condensation polymer.
4. Buna-S is obtained by polymerization of 1,3-butadiene and styrene in the ratio of 3 : 1 in the presence of sodium.
5. Natural rubber is a polymer of chloroprene.
6. Glycine gives purple colour with ninhydrin while acetamide does not.
7. Raffinose is a trisaccharide and on hydrolysis it gives three molecules of monosaccharide units one each of glucose, fructose and galactose.
8. According to Maxwell distribution law, at high temperatures a greater fraction of the molecules can be expected to have high speeds than at low temperatures.
9. The entropy of a perfectly ordered crystalline substance at 0 K is zero.

16. When the following aldohexose exists in its *D*-configuration, the total number of stereoisomers in its pyranose form is



17. Compound 'X' is used as a source of oxygen in submarines, space shuttles and in emergency breathing apparatus (oxygen mask).



When two moles of 'X' are dissolved in 2 moles of water, then how many moles of H_2O_2 are formed?

18. $\text{Fe}^{2+} \xrightarrow{\text{KCN}}$ yellowish-brown ppt. $\xrightarrow{\text{excess KCN}}$

pale yellow solution (X)

In compound (X), the total number of unpaired electrons present on central metal atom is

SECTION IV

This section contains 3 questions. Each question contains statements given in 2 columns. Statements in the first column have to be matched with statements in the second column. The answers to these questions have to be appropriately bubbled in the ORS as per the instructions. For each question in this section, you will be awarded 8 marks if you darken all the bubbles corresponding only to the correct answer and 2 marks for each row. No negative mark will be awarded for an incorrectly bubbled answer.

19. Match the following :

Column-I (Compounds)		Column-II (pK_a values)	
(A)		(p)	-2.7
(B)		(q)	5.3

(C)		(r)	10
(D)		(s)	6.2

20. Match the following :

List-I		List-II	
(A)	Cu^{2+}	(p)	forms amphoteric oxide
(B)	Zn^{2+}	(q)	forms diamagnetic and colourless compounds
(C)	Cr^{3+}	(r)	forms complex with NH_3
(D)	Sc^{3+}	(s)	forms complex with KCN

21. Match the following :

List-I		List-II	
(A)	A compound which cannot form stereoisomers	(p)	$[\text{Pt}(\text{NH}_3)_2\text{NO}_2\text{Cl}]$
(B)	A compound in which metal involves six orbitals in hybridization	(q)	$[\text{Pt}(\text{NH}_3)_4\text{ClBr}]\text{SO}_4$
(C)	Complex can show ionization isomerism	(r)	$[\text{Pt}(\text{NH}_3)_3\text{Cl}]\text{Br}$
(D)	A compound which can form <i>cis</i> , <i>trans</i> -isomers	(s)	$[\text{Pt}(\text{NH}_3)\text{Cl}_5]^-$

ANSWERS

PAPER – I

1. (d) 2. (b) 3. (b) 4. (d) 5. (c)
 6. (a) 7. (c) 8. (b) 9. (c) 10. (a, b, c)
 11. (a, b, c, d) 12. (b, c) 13. (b, c) 14. (a, c, d)
 15. (c) 16. (b) 17. (a) 18. (b) 19. (a)
 20. (b) 21. [4] 22. [3] 23. [3] 24. [5]
 25. [4] 26. [4] 27. [4] 28. [8]

PAPER – II

1. (b) 2. (c) 3. (b) 4. (d) 5. (a)
 6. (d) 7. (b) 8. (c) 9. (c) 10. (b)
 11. (b) 12. (b) 13. (a) 14. [6] 15. [5]
 16. [8] 17. [1] 18. [0]
 19. A - s ; B - p ; C - q ; D - r
 20. A - r, s ; B - p, q, r, s ; C - p, r, s ; D - q
 21. A - r, s ; B - q, s ; C - q, r ; D - p, q

For detailed solutions to the Sample Paper, visit our website : www.vidyalankar.org





CONCEPT BOOSTER

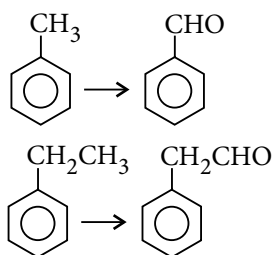
Hello students!! This is the last part of REDUCTION-OXIDATION series. Through this article, I have tried to show you the different functions of a reducing or an oxidising agent. I strongly believe that you will be able to solve the questions based on this topic very easily. Keep practicing. All the very best!!

*Arunava Sarkar

DEALING WITH OXIDATION

Chromyl chloride (CrO_2Cl_2) in CCl_4 i.e., Etard reagent

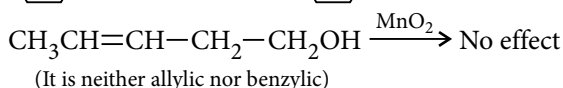
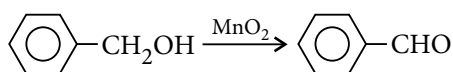
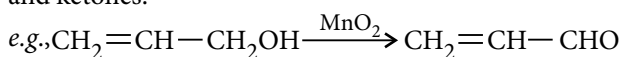
Usual conversions are :



Similar performance is also given by CrO_3 in acetic anhydride medium.

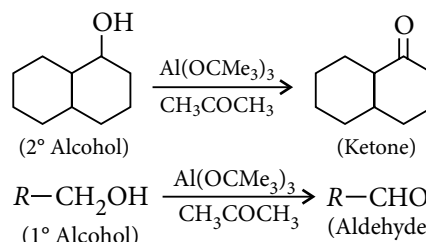
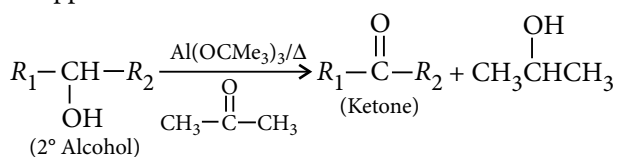
MnO_2 (Manganese dioxide)

It is a mild and selective oxidising agent. It converts only 1° and 2° allylic or benzylic alcohols to aldehydes and ketones.



Oppenauer Oxidation

Oxidation of alcohol with aluminium tertiary butoxide is Oppenauer oxidation.



Oppenauer oxidation has nothing to do with the multiple bonds.

NBS (N-Bromosuccinimide)

Usual conversions are :

(a) 1° alcohol \longrightarrow aldehyde

(b) 2° alcohol \longrightarrow ketone

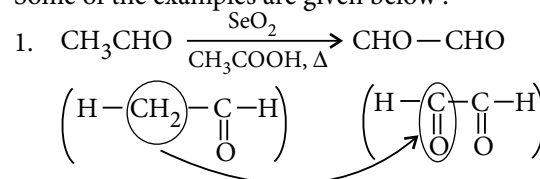
(c) bromination at the allylic position.

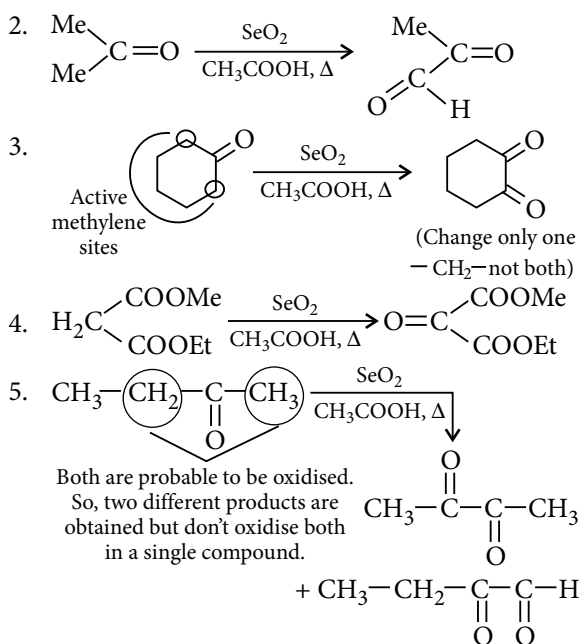
3° alcohol is not affected at all by NBS.

SeO_2 (Selenium dioxide)

SeO_2 is usually used with acetic acid or acetic anhydride medium. Usual temperature is 100°C - 150°C.

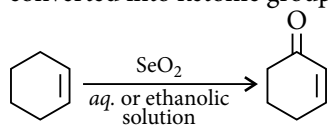
○ SeO_2 is a selective oxidising agent and it converts $-\text{CH}_2-$ group which is adjacent to carbonyl group into carbonyl ($>\text{C}=\text{O}$) group. In general, this reagent oxidises active methylene and active methyl groups to ketonic and aldehydic groups respectively. Some of the examples are given below :





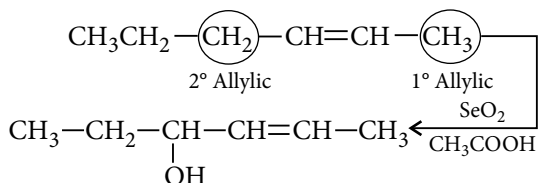
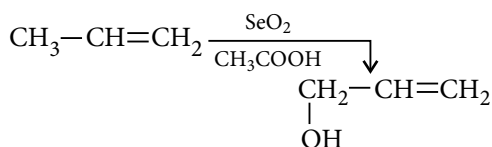
There are some more tasks which are performed by SeO_2 . e.g.,

(a) If a ring contains a double bond, then methylene at the α -position to the double bond gets converted into ketonic group.



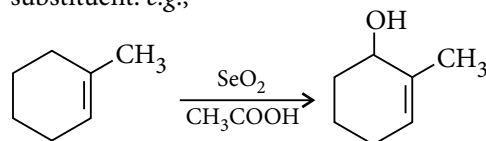
(b) SeO_2 also performs hydroxylation. Hydroxylation is mainly done under three conditions:

(i) It hydroxylates the allylic position and always a higher degree allylic position is hydroxylated. e.g.,

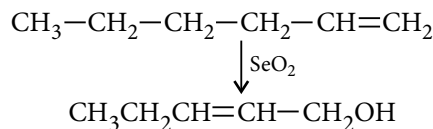


(ii) If there is a double bond in a ring and either both or any of the double bonded carbon atoms are/is substituted then $-\text{OH}$ group gets attached to the carbon adjacent to the

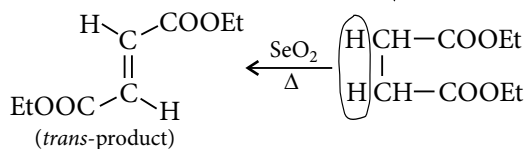
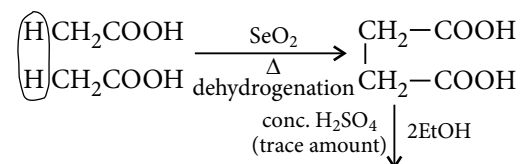
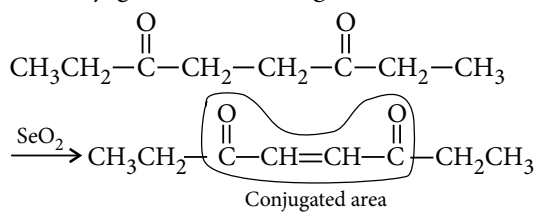
double bonded carbon atom bearing the substituent. e.g.,



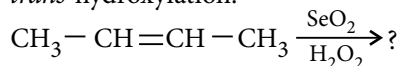
(iii) If there is a terminal double bond in a compound (better if any other bond or group is not present in the compound) then on treatment with SeO_2 , it is converted to an alcohol with the migration of double bond at the allylic position. e.g.,



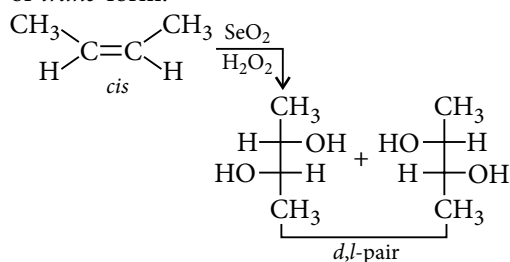
(c) Dehydrogenation takes place at relatively higher temperature specially to get a stable structure i.e., conjugated structure. e.g.,



(d) When H_2O_2 is present then SeO_2 helps to cause *trans*-hydroxylation.

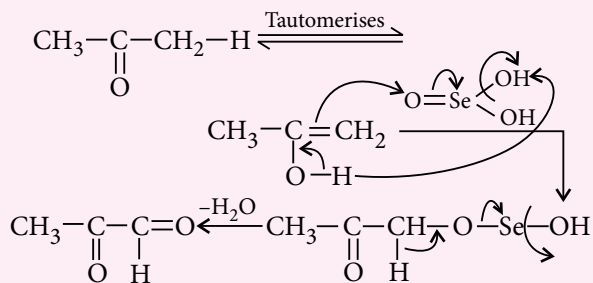


$\text{CH}_3-\text{CH}=\text{CH}-\text{CH}_3$ can exist either in *cis* or *trans*-form.

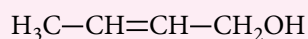


Mechanistic pathway of SeO₂ :

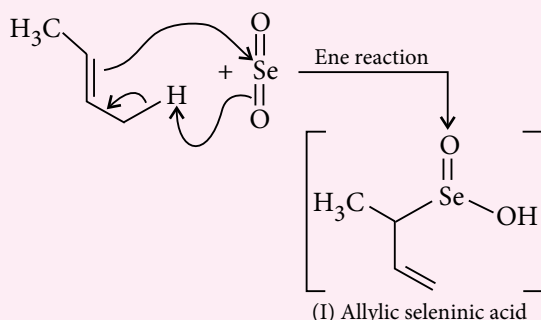
- (i) When $-\text{CH}_2$ group gets converted to $-\text{C}=\text{O}$ group :



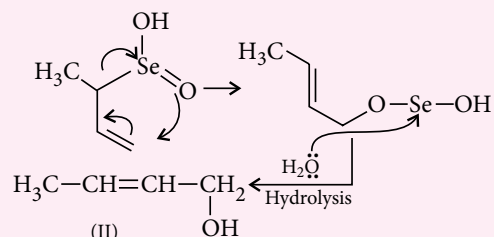
- (ii) Hydroxylation : Consider the reaction,



Here, reaction proceeds *via* an initial ene reaction of allylic compounds and it gives allylic seleninic acid that undergoes a [2, 3]-sigmatropic reaction followed by hydrolysis to give allylic alcohol.

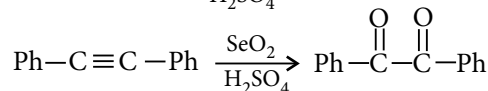
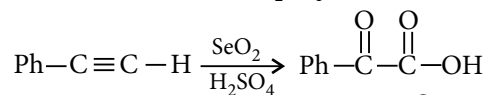
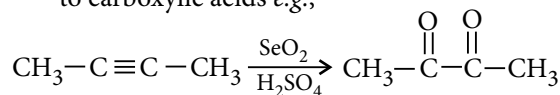


- (I) can be rewritten as below :



+ Se by-products

- (e) Another important use of SeO₂ is that, it converts/oxidises alkynes to vicinal dicarbonyl compounds. A trace amount of H₂SO₄ is required. Internal alkynes are converted to α -diketones and terminal alkynes get converted to carboxylic acids e.g.,



SOLUTIONS OF MARCH 2016 CROSSWORD

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Winners of March 2016 Crossword

- Paridhi Jain (Meerut)
- Tejinder Singh Rawat (Uttarakhand)

Winners of February 2016 Crossword

- Shivani Sharma (Gujarat)

Solution Senders of Chemistry Musing

Set 31

- Divyesh Saglani, Hyderabad
- Debdutta Bose, West Bengal

Solution Senders of Chemistry Musing

Set 32

- Yakaiah Chennori, Talangana
- Swastik Biswas, West Bengal
- Arnab Jana, West Bengal
- Indranil Jana, West Bengal
- Samrat Gupta, West Bengal

CBSE BOARD SOLVED PAPER

2016

CLASS XII

Time Allowed : 3 hours

Maximum Marks : 70

GENERAL INSTRUCTIONS

- (i) All questions are compulsory.
- (ii) Q. no. 1 to 5 are very short answer questions and carry 1 mark each.
- (iii) Q. no. 6 to 10 are short answer questions and carry 2 marks each.
- (iv) Q. no. 11 to 22 are also short answer questions and carry 3 marks each.
- (v) Q. no. 23 is a value based question and carry 4 marks.
- (vi) Q. no. 24 to 26 are long answer questions and carry 5 marks each.
- (vii) Use log tables if necessary, use of calculators is not allowed.

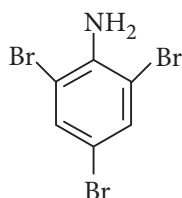
1. What type of magnetism is shown by a substance if magnetic moments of domains are arranged in same direction?

2. Out of $\text{CH}_3-\underset{\text{CH}_3}{\text{CH}}-\text{CH}_2-\text{Cl}$ and $\text{CH}_3-\text{CH}_2-\underset{\text{CH}_3}{\text{CH}}-\text{Cl}$, which is more reactive towards $\text{S}_{\text{N}}1$ reaction and why?

3. On adding NaOH to ammonium sulphate, a colourless gas with pungent odour is evolved which forms a blue coloured complex with Cu^{2+} ion. Identify the gas.

4. Write the main reason for the stability of colloidal sols.

5. Write the IUPAC name of the given compound :



6. When a coordination compound $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$ is mixed with AgNO_3 , 2 moles of AgCl are precipitated per mole of the compound. Write

(i) Structural formula of the complex.

(ii) IUPAC name of the complex.

7. From the given cells :

Lead storage cell, mercury cell, fuel cell and dry cell
Answer the following :

- (i) Which cell is used in hearing aids?
- (ii) Which cell was used in Apollo Space Programme?
- (iii) Which cell is used in automobiles and inverters?
- (iv) Which cell does not have long life?

8. When chromite ore FeCr_2O_4 is fused with NaOH in presence of air, a yellow coloured compound (A) is obtained which on acidification with dilute sulphuric acid gives a compound (B). Compound (B) on reaction with KCl forms an orange coloured crystalline compound (C).

(i) Write the formulae of the compound (A), (B) and (C).

(ii) Write one use of compound (C).

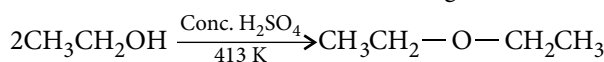
OR

Complete the following chemical equations :

(i) $8\text{MnO}_4^- + 3\text{S}_2\text{O}_3^{2-} + \text{H}_2\text{O} \rightarrow$

(ii) $\text{Cr}_2\text{O}_7^{2-} + 3\text{Sn}^{2+} + 14\text{H}^+ \rightarrow$

9. Write the mechanism of the following reaction :



10. For a reaction : $2\text{NH}_3(\text{g}) \xrightarrow{\text{Pt}} \text{N}_2(\text{g}) + 3\text{H}_2(\text{g})$
Rate = k

- (i) Write the order and molecularity of this reaction.
(ii) Write the unit of k .

11. The rate constant for the first order decomposition of H_2O_2 is given by the following equation :

$$\log k = 14.2 - \frac{1.0 \times 10^4}{T} \text{ K}$$

Calculate E_a for this reaction and rate constant k if its half-life period is 200 minutes.

(Given : $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)

12. (i) Differentiate between adsorption and absorption.
(ii) Out of MgCl_2 and AlCl_3 , which one is more effective in causing coagulation of negatively charged sol and why?
(iii) Out of sulphur sol and proteins, which one forms multimolecular colloids?

13. Give reasons :

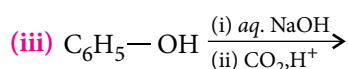
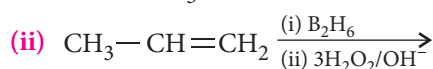
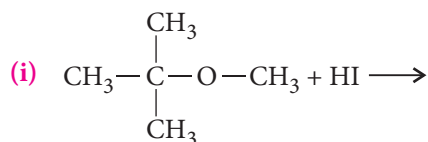
- (i) C — Cl bond length in chlorobenzene is shorter than C — Cl bond length in $\text{CH}_3 - \text{Cl}$.
(ii) The dipole moment of chlorobenzene is lower than that of cyclohexyl chloride.
(iii) $\text{S}_\text{N}1$ reactions are accompanied by racemization in optically active alkyl halides.

14. An element crystallizes in a f.c.c. lattice with cell edge of 250 pm. Calculate the density if 300 g of this element contain 2×10^{24} atoms.

15. Give reasons :

- (i) Mn shows the highest oxidation state of +7 with oxygen but with fluorine it shows the highest oxidation states of +4.
(ii) Transition metals show variable oxidation states.
(iii) Actinoids show irregularities in their electronic configurations.

16. Write the main product(s) in each of the following reactions :

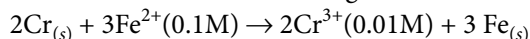


17. (i) Name the method of refining of metals such as germanium.

- (ii) In the extraction of Al, impure Al_2O_3 is dissolved in conc. NaOH to form sodium aluminate and leaving impurities behind. What is the name of this process?

- (iii) What is the role of coke in the extraction of iron from its oxides?

18. Calculate e.m.f of the following cell at 298 K :



Given : $E^\circ_{(\text{Cr}^{3+} | \text{Cr})} = -0.74 \text{ V}$, $E^\circ_{(\text{Fe}^{2+} | \text{Fe})} = -0.44 \text{ V}$

19. (i) Write the names of two monosaccharides obtained on hydrolysis of lactose sugar.

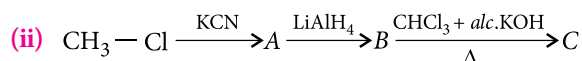
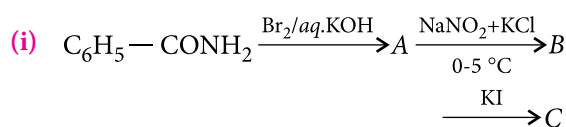
- (ii) Why Vitamin C cannot be stored in our body?

- (iii) What is the difference between a nucleoside and nucleotide?

20. (i) For the complex $[\text{Fe}(\text{CN})_6]^{3-}$, write the hybridization type, magnetic character and spin nature of the complex. (At. number : Fe = 26)

- (ii) Draw one of the geometrical isomers of the complex $[\text{Pt}(\text{en})_2\text{Cl}_2]^{2+}$ which is optically active.

21. Write the structures of A, B and C in the following :



22. (i) What is the role of *t*-butyl peroxide in the polymerization of ethene?

- (ii) Identify the monomers in the following polymer : $[-\text{NH}(\text{CH}_2)_6\text{NHCO}(\text{CH}_2)_4\text{CO}-]_n$

- (iii) Arrange the following polymers in the increasing order of their intermolecular forces : Polystyrene, Terylene, Buna-S

OR

Write the mechanism of free radical polymerization of ethene.

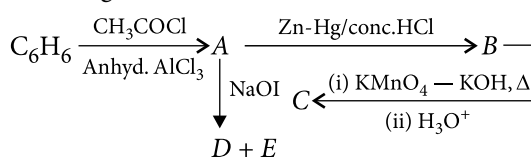
23. Due to hectic and busy schedule, Mr. Angad made his life full of tensions and anxiety. He started taking sleeping pills to overcome the depression without consulting the doctor. Mr. Deepak, a close friend of Mr. Angad, advised him to stop taking sleeping pills

and suggested to change his lifestyle by doing yoga, meditation and some physical exercise. Mr. Angad followed his friend's advice and after few days he started feeling better.

After reading the above passage, answer the following :

- (i) What are the values (at least two) displayed by Mr. Deepak?
- (ii) Why is it not advisable to take sleeping pills without consulting doctor?
- (iii) What are tranquilizers? Give two examples.

24. Write the structures of A, B, C, D and E in the following reactions :



OR

- (i) Write the chemical equation for the reaction involved in Cannizzaro reaction.
- (ii) Draw the structure of the semicarbazone of ethanal.
- (iii) Why pK_a of FCH_2COOH is lower than that of ClCH_2COOH ?
- (iv) Write the product in the following reaction :



- (v) How can you distinguish between propanal and propanone?

25. (i) Calculate the freezing point of solution when 1.9 g of MgCl_2 ($M = 95 \text{ g mol}^{-1}$) was dissolved in 50 g of water, assuming MgCl_2 undergoes complete ionization.

(K_f for water = $1.86 \text{ K kg mol}^{-1}$)

- (ii) (a) Out of 1 M glucose and 2 M glucose, which one has a higher boiling point and why?
- (b) What happens when the external pressure applied becomes more than the osmotic pressure of solution?

OR

- (i) When 2.56 g of sulphur was dissolved in 100 g of CS_2 , the freezing point lowered by 0.383 K. Calculate the formula of sulphur (S_x).
[K_f for $\text{CS}_2 = 3.83 \text{ K kg mol}^{-1}$, Atomic mass of sulphur = 32 g mol^{-1}]

- (ii) Blood cells are isotonic with 0.9% sodium chloride solution. What happens if we place blood cells in a solution containing
(a) 1.2% sodium chloride solution?
(b) 0.4% sodium chloride solution?

26. (i) Account for the following :

- (a) Ozone is thermodynamically unstable.
- (b) Solid PCl_5 is ionic in nature.
- (c) Fluorine forms only one oxoacid HOF.

- (ii) Draw the structure of

- (a) BrF_5
- (b) XeF_4

OR

- (i) Compare the oxidizing action of F_2 and Cl_2 by considering parameters such as bond dissociation enthalpy, electron gain enthalpy and hydration enthalpy.

- (ii) Write the conditions to maximize the yield of H_2SO_4 by Contact process.

- (iii) Arrange the following in the increasing order of property mentioned :

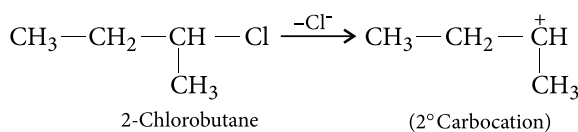
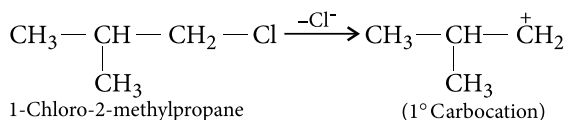
- (a) H_3PO_3 , H_3PO_4 , H_3PO_2 (Reducing character)
- (b) NH_3 , PH_3 , AsH_3 , SbH_3 , BiH_3 , (Base strength)

SOLUTIONS

1. Refer answer 110(b), Page No. 50

(MTG Excel in Chemistry)

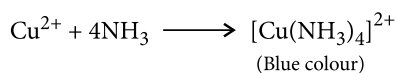
2. The $\text{S}_{\text{N}}1$ reaction proceeds through carbocation formation thus, the compound which forms more stable carbocation will be more reactive.



As, 2° carbocation is more stable than 1° carbocation thus, 2-chlorobutane is more reactive towards $\text{S}_{\text{N}}1$ reaction.

3. $(\text{NH}_4)_2\text{SO}_4 + 2\text{NaOH} \xrightarrow{\Delta} 2\text{NH}_3 + \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$

(colourless
and pungent
odoured gas)



(Blue colour)

4. The main reason for the stability of colloids is the electrostatic stabilisation *i.e.*, equal and same type of charge on the colloidal particles which causes repulsion between them and prevents the coagulation of the sol.

5. 2, 4, 6-Tribromoaniline

6. (i) For one mole of the compound, two moles of AgCl are precipitated which indicates two ionisable chloride ions in the complex. Hence, its structural formula is $[\text{CrCl}(\text{H}_2\text{O})_5]\text{Cl}_2 \cdot \text{H}_2\text{O}$

(ii) Pentaquachloridochromium(III) chloride

7. (i) Refer answer 46, Page No. 126

(MTG Excel in Chemistry)

(ii) Refer answer 56, Page No. 126

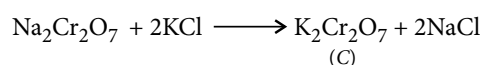
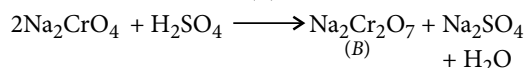
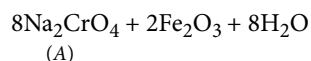
(MTG Excel in Chemistry)

(iii) Refer answer 50, Page No. 126

(MTG Excel in Chemistry)

(iv) Dry cell

8. (i) $4\text{FeCr}_2\text{O}_4 + 16\text{NaOH} + 7\text{O}_2 \longrightarrow$



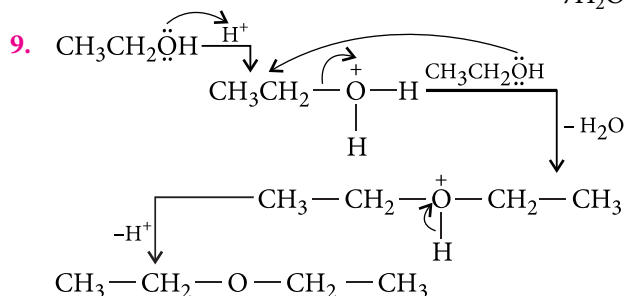
- (ii) Potassium dichromate is used as a powerful oxidising agent in industries and for staining and tanning of leather.

OR

- (i) Refer answer 60(a)(i), Page No. 337

(MTG Excel in Chemistry)

- (ii) $\text{Cr}_2\text{O}_7^{2-} + 3\text{Sn}^{2+} + 14\text{H}^+ \longrightarrow 2\text{Cr}^{3+} + 3\text{Sn}^{4+} + 7\text{H}_2\text{O}$



10. (i) According to rate law expression, rate of the reaction is independent of concentration of reactant. Thus, the order of the reaction is zero. However, two molecules of ammonia react to give products thus, the molecularity is two.

- (ii) For a zero order reaction, unit of rate constant is $\text{mol L}^{-1} \text{sec}^{-1}$.

11. For first order reaction, $t_{1/2} = \frac{0.693}{k}$

$$t_{1/2} = 200 \text{ min} = 200 \times 60 = 12000 \text{ s}$$

$$\Rightarrow k = \frac{0.693}{12000 \text{ s}} = 5.8 \times 10^{-5} \text{ s}^{-1}$$

Also, for first order decomposition of H_2O_2 , rate constant is

$$\log k = 14.2 - \frac{1.0 \times 10^4}{T} \text{ K}$$

Comparing the above equation with the Arrhenius equation,

$$\log k = \log A - \frac{E_a}{2.303RT}$$

$$\Rightarrow E_a = 2.303 \times 8.314 \times 1.0 \times 10^4 = 1.91 \times 10^5 \text{ J mol}^{-1}$$

12. (i) Refer answer 1 (Textbook Exercise), Page No. 196
(MTG Excel in Chemistry)

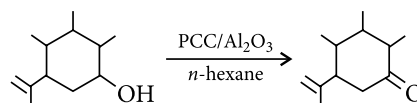
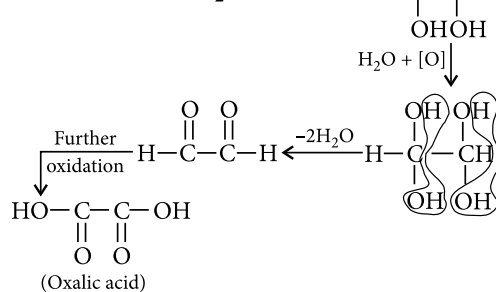
- (ii) According to Hardy-Schulze rule, for negatively charged sol greater the valency of positive ion added to it, greater is its coagulation power. In AlCl_3 , Al has +3 charge which is more than Mg with +2 charge in MgCl_2 . Thus, AlCl_3 is more effective in causing coagulation of negatively charged sol.

- (iii) Proteins are macromolecules which cannot form multimolecular colloids while sulphur sol have smaller S_8 molecules which can form multimolecular colloids.

ERRATA

Chemistry Today, page no. 28 March 2016 issue

- (b) $\text{H}-\text{C}\equiv\text{C}-\text{H} + \text{H}_2\text{O} + [\text{O}] \longrightarrow \text{H}-\text{C}=\text{C}-\text{H}$



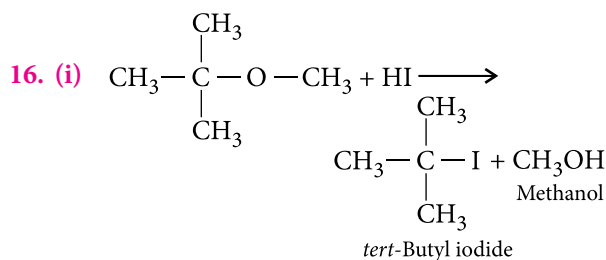
13. (i) Refer answer 73(i), Page No. 416
(MTG Excel in Chemistry)
(ii) Refer answer 12(i), Page No. 395
(MTG Excel in Chemistry)
(iii) Refer answer 1, Page No. 405
(MTG Excel in Chemistry)

14. Molar mass of element (M)

$$= \frac{300 \times 6.02 \times 10^{23}}{2 \times 10^{24}} = 90.3 \text{ g mol}^{-1}$$

$$\text{Density } (d) = \frac{ZM}{a^3 N_A} = \frac{4 \times 90.3}{(250 \times 10^{-10})^3 \times 6.02 \times 10^{23}} = 38.4 \text{ g cm}^{-3}$$

15. (i) Manganese can form $p\pi - d\pi$ bond with oxygen by utilising $2p$ -orbital of oxygen and $3d$ -orbital of manganese due to which it can show highest oxidation state of +7. While with fluorine it cannot form such $p\pi - d\pi$ bond thus, it can show a maximum of +4 oxidation state.
(ii) Refer answer 7, Page No. 324
(MTG Excel in Chemistry)
(iii) Refer answer 39, Page No. 324
(MTG Excel in Chemistry)



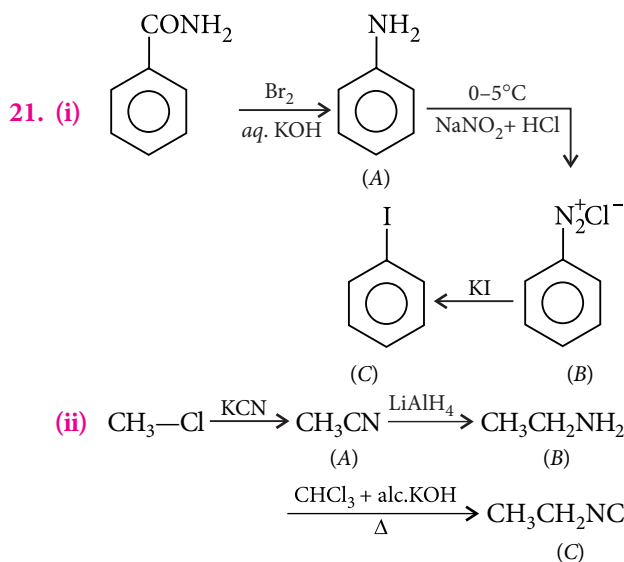
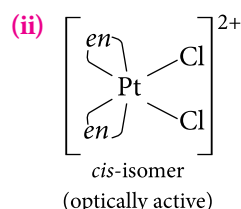
- (ii) Refer answer 6, Page No. 436
(MTG Excel in Chemistry)
(iii) Refer answer 9(ii), Page No. 434
(MTG Excel in Chemistry)
17. (i) Refer answer 36, Page No. 231
(MTG Excel in Chemistry)
(ii) $\text{Al}_2\text{O}_3 + 2\text{NaOH} + 3\text{H}_2\text{O} \longrightarrow 2\text{Na}[\text{Al}(\text{OH})_4]$
 Alumina Sodium aluminate
 This process is known as leaching.
(iii) Refer answer 27, Page No. 231
(MTG Excel in Chemistry)

18.
$$E_{\text{cell}} = (E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}) - \frac{2.303RT}{nF} \log \frac{[\text{Cr}^{3+}]^2}{[\text{Fe}^{2+}]^3}$$

$$= \{-0.44 - (-0.74)\} - \frac{0.0591}{6} \log \frac{(0.01)^2}{(0.1)^3}$$

$$= 0.30 - 0.01(-1) = 0.31\text{V}$$

19. (i) Refer answer 31, Page No. 584
(MTG Excel in Chemistry)
(ii) Vitamin C is water soluble and hence cannot be stored in our body.
(iii) Refer answer 124, Page No. 586
(MTG Excel in Chemistry)
20. (i) Refer answer 12, Page No. 369
(MTG Excel in Chemistry)



22. (i) Polymerisation of ethene requires an initiator to start the polymerisation with free radical mechanism. Thus, peroxide like *t*-butyl peroxides decomposes to give free radical that initiates the reaction.
(ii) Refer answer 3(i), Page No. 610
(MTG Excel in Chemistry)
(iii) The intermolecular forces are least in case of elastomers like Buna-S while strongest in case of fibres like terylene and in case of thermoplastics like polystyrene the intermolecular forces are intermediate between elastomers and fibres. Thus, the increasing order of their intermolecular forces is Terylene > Polystyrene > Buna-S

OR

- Refer answer 10, Page No. 611
(MTG Excel in Chemistry)

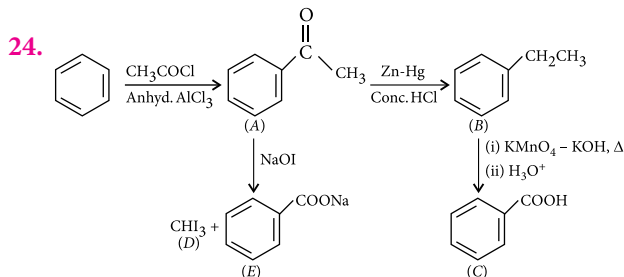
23. (i) Awareness about drugs and concern for his friend's health are the values displayed by Mr. Deepak.

(ii) Refer answer 1(Intext Questions),
Page No. 634 (MTG Excel in Chemistry)

(iii) Refer answer 5(ii), Page No. 642
(MTG Excel in Chemistry)

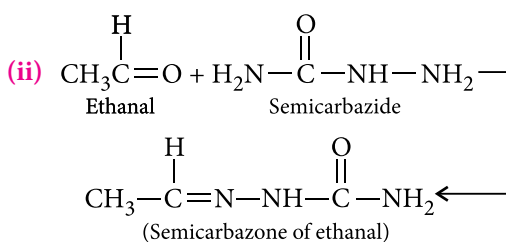
Refer answer 6, Page No. 639

(MTG Excel in Chemistry)

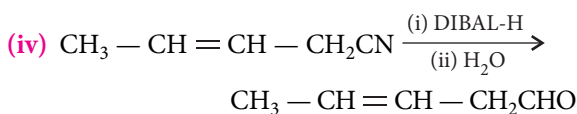


OR

(i) Refer answer 16(ii), Page No. 485
(MTG Excel in Chemistry)



(iii) Fluorine being more electronegative than chlorine will stabilize the carboxylate ion to a greater extent. Thus, K_a of fluoroacetic acid is higher than chloroacetic acid. Hence, inverse is the order of pK_a values of these acids.



(v) Refer answer 42(i), Page No. 498
(MTG Excel in Chemistry)

25. (i) $\Delta T_f = iK_f m$
 i for $\text{MgCl}_2 = 3$

$$\text{Molality, } m = \frac{1.9 \times 1000}{95 \times 50} = 0.4$$

$$\Delta T_f = 3 \times 1.86 \times 0.4 = 2.232 \text{ K}$$

$$\text{Freezing point of solution} = 273 - 2.232 \text{ K} = 270.77 \text{ K}$$

(ii) (a) The elevation in boiling point of a solution is a colligative property which depends on the number of moles of solute added. Higher the concentration of solute added, higher will be the elevation in boiling point. Thus, 2M glucose has higher boiling point than 1M glucose solution.

(b) When the external pressure applied becomes more than the osmotic pressure of solution then the solvent molecules from the solution pass through the semipermeable membrane to the solvent side and the process is called reverse osmosis.

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OR

(i) $\Delta T_f = iK_f m$

$$m = \frac{2.56 \times 1000}{32 \times 100} = 0.8$$

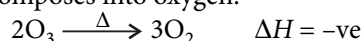
$$\Rightarrow 0.383 = i \times 3.83 \times 0.8 \Rightarrow i = \frac{1}{8}$$

Thus, sulphur undergoes association to give S_8 .

(ii) (a) 1.2% sodium chloride solution is hypertonic with respect to 0.9% sodium chloride solution or blood cells thus, on placing blood cells in this solution exosmosis takes place that results in shrinking of cells.

(b) 0.4% sodium chloride solution is hypotonic with respect to 0.9% sodium chloride solution or blood cells thus, on placing blood cells in this solution endosmosis takes place that results in swelling of cells.

26. (i) (a) Ozone is thermodynamically unstable and decomposes into oxygen.



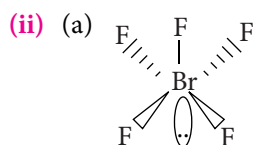
The above conversion is exothermic i.e., ΔH is negative. Also, entropy increases i.e., $\Delta S = +ve$. Thus, ΔG for the decomposition of ozone is negative. Hence, it is thermodynamically unstable.

(b) Refer answer 23(v), Page No. 280

(MTG Excel in Chemistry)

(c) Refer answer 24, Page No. 268

(MTG Excel in Chemistry)



(b) Refer answer 5(i), Page No. 277

(MTG Excel in Chemistry)

OR

(i) Oxidising power of a substance depends on the factors like bond dissociation enthalpy, electron gain enthalpy and hydration enthalpy. Due to small size of fluorine, its electron gain enthalpy is less than that of chlorine. However, its low bond dissociation enthalpy and high hydration enthalpy compensate the low electron gain enthalpy. Fluorine because of its small size has higher hydration enthalpy than chlorine. Also, due to repulsion between electrons it has lower bond dissociation energy. Thus, fluorine has better oxidising action than chlorine.

(ii) In Contact process, the rate determining step is $2SO_2 + O_2 \rightleftharpoons 2SO_3$, $\Delta_r H^\circ = -196.6 \text{ kJ mol}^{-1}$

This reaction is reversible and exothermic i.e., ΔH is negative. Thus, according to Le-Chatelier's principle, the conditions to maximise the yield are as follows :

(a) At lower temperature : As heat is evolved in the reaction so, at lower temperature the reaction proceeds more in forward direction.

(b) At higher pressure : As three moles of gaseous reactants give two moles of gaseous products thus, at higher pressure reaction moves in forward direction.

(iii) (a) Reducing character of oxyacids of phosphorus depends on the number of P-H bonds. More the number of P-H bonds in oxyacid, more is the reducing character. H_3PO_2 has two P-H bonds, H_3PO_3 has one P-H bond and H_3PO_4 has no P-H bond. Thus, order of reducing character is $H_3PO_2 > H_3PO_3 > H_3PO_4$

(b) Refer answer 36(iii), Page No. 269

(MTG Excel in Chemistry)



DID YOU KNOW ?

◆ Aluminium was More Precious than Gold

Due to the complexities of refining aluminium from ore in the past, aluminium was considered more rare and precious than gold or silver through most of the 19th century. Napoleon III, the first President of the French Republic, served his state dinners on aluminium plates. Rank-and-file guests were served on dishes made with gold or silver. A pure form of the metal was first successfully extracted from ore in 1825 by Danish chemist Hans-Christian.

◆ Platinum was Once Used Only by Military

Although platinum is regarded as a "new" metal in its present form, it has a long history. Ancient Egyptians and Indians already valued it as a very important element. The production of platinum requires very complex processing techniques that were not available until the end of the 19th century. During World War II the availability of platinum was limited since it was declared as a strategic material. Use of platinum for most non-military applications was prohibited. After the war, consumption of platinum increased due to its catalytic properties.



EXAM READY

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There are 2 main types of things you need to demonstrate in the exam :

- (i) Knowledge of the topics – you need to develop your memory.
- (ii) Skills of the historian – you need to use sources in an efficient way.

WHAT TO DO?

- Do your very best to get specimen papers/ previous solved papers and to make sure that you know the exact format of the exam and the kinds of questions asked in the exam.
- Decide how much of the syllabus you need to cover so that you can safely answer enough questions. But make sure you read every topic atleast once.
- Keep some “Recap slots” so that you can spend extra time on harder topics, review what you have already learnt, or catch up if you have fallen behind.
- Reduce the bulk of your notes down to key ideas.
- Make question banks and summaries.
- To develop memory, work out how the course is organised and make a revision plan that reflects this. Try to plan in time to do all the topics more than once, rather than saying “I’ll revise everything once really well”
- Learn how to use new strategies for learning, remembering, and thinking.
- Join or form a study group to practice multiple choice questions of various levels.
- Study old question papers and examine each question to determine :
 - the level or type of thinking required
 - the degree of difference between incorrect and correct alternatives.
- Consider “all of the above” and “none of the above.” Examine the “above” alternatives to see if all of them or none of them apply totally. If even one does not apply totally, do not consider “all of the above” or “none of the above” as the correct answer. Make sure that a statement applies to the question since it can be true, but not be relevant to the question at hand!
- **Note negatives** : If a negative such as “none”, “not”, “never”, or “neither” occurs in the stem, know that the correct alternative must be a fact or absolute and that the other alternatives could be true statements, but not the correct answer.
- **Note superlatives** : Words such as “every”, “all”, “none”, “always”, and “only” are superlatives that indicate the correct answer must be an undisputed fact.
- **Note qualifying words** : “Usually”, “often”, “generally”, “may”, and “seldom” are qualifiers that could indicate a true statement.
- Use your knowledge of headings to think about where in your text, lecture notes, lab, etc. that question is drawn from. Recall a few salient points about the information. If necessary, jot down any relevant facts you need to process the alternatives. This does not have to take much time but this recall is an essential step!
- If you were unable to make a choice and need to spend more time with the question, or you answered the question but are not at all sure that you made the correct choice, put a big question mark beside that question, and move on to the next. Avoid getting bogged down on one question part of the way through the exam. It is much better to move on and finish all those questions that you can answer and then to come back later to process the problematic questions.
- Don’t dismiss an alternative because it seems too obvious and simple to answer. If you are well prepared for the exam, some of the questions will appear very straightforward to you.
- Don’t pick your answer based on a pattern of responses, *i.e.*, don’t say to yourself, “This can’t be another “b” answer as we have just had three in a row.”

Attempting multiple choice exams

- Read the stem with each alternative to take advantage of the correct sound or flow that the correct answer often produces. Also, you can eliminate any alternative that does not agree grammatically with the stem.



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ACROSS

1. Latin name of gold. (5)
8. Tube used as a source of microwave radiations. (8)
9. Product obtained by reducing formaldehyde sodium bisulphite derivative which is used as a reducing agent in vat dyeing. (9)
11. Instrument used to measure the extent of rotation of polarised light. (11)
12. SI unit of radioactivity. (9)
14. Tetraethyl lead is used as an _____ agent to improve the quality of gasoline. (9)
15. Nucleophiles which can attack through two or more atoms. (8)
16. Test given by compounds having —NHCO— group. (6)
17. Nitrogen fixing bacteria. (11)
24. Orbitals which have the same sign at the same distance in opposite directions from the centre of symmetry. (6)
26. Constituent of chlorophyll. (9)
27. Elements showing metallic and non-metallic properties. (10)
28. Metal having highest melting point. (8)
29. Father of modern chemistry. (9)

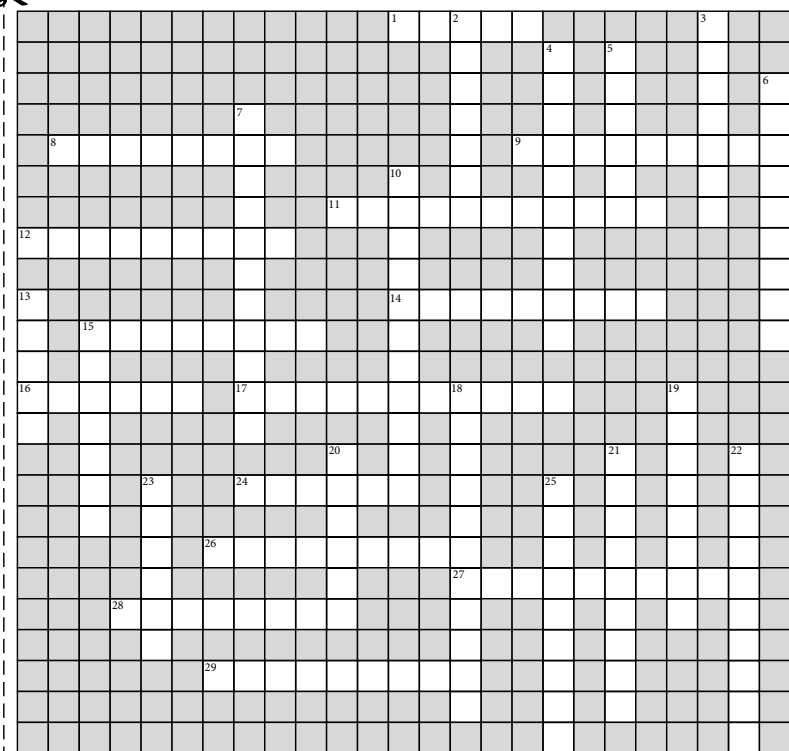
DOWN

2. A sulphide ore of arsenic. (7)
3. Lightest radioactive element. (7)
4. A crystalline solid used as hypnotic (drug) in medicine and is obtained when chloroform condenses with acetone in basic medium. (10)
5. Undesired impurities present in ores. (6)
6. Compound used for artificial ripening of fruits. (9)
7. Phenomenon of disappearance of boundary between two particles in contact. (11)

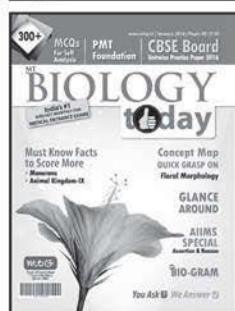
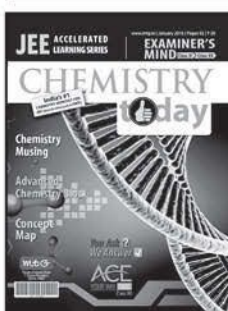
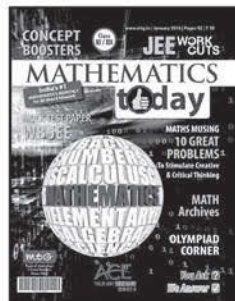
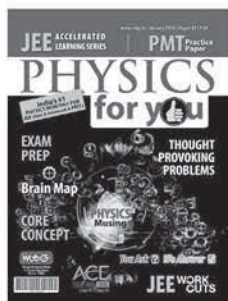
10. An artificial Lapis-Lazuli, a pigment used in making blue-paint. (11)
13. In F-centre, 'F' stands for _____. (5)
15. Colloidal solution where water is used as a dispersion medium. (7)
18. Necessary and sufficient condition for the existence of enantiomers. (11)
19. Process in which energy is released. (8)
20. Emulsifying agent in milk. (6)
21. Most unsymmetrical crystal system. (9)
22. Another name of methyl alcohol. (10)
23. Most common method used for the estimation of sulphur. (6)
25. Another name of saturated hydrocarbons. (9)



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